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AMERICAN JOURNAL *of* PHARMACY

SINCE 1825

A Record of the Progress of Pharmacy and the Allied Sciences

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Vol. 96

OCTOBER, 1924

No. 10

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Price \$3.00 per Annum in Advance.

Foreign Postage, 25 Cents Extra.

Single Numbers, 30 Cents. Back Numbers, 50 Cents.

Entered as Second-Class Matter at the Post Office at Philadelphia, Pa., Under the
Act of March 3, 1879.

Acceptance for Mailing at Special Rate of Postage Provided for in Section 1103, Act of
October 3, 1917. Authorized February 13, 1920.

PUBLISHED MONTHLY BY THE

Philadelphia College of Pharmacy and Science

145 North Tenth Street, Philadelphia

American Journal of Pharmacy

ESTABLISHED IN 1825

Four preliminary numbers were published at different times until in 1829, when the publication of the regular volumes began. Since then the publication has been uninterrupted. During the period from 1829 to 1852 four numbers were published annually, except in 1847, when five numbers were published. From 1853 to 1870 six numbers were published. Since this time twelve numbers have been published annually.

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	2 pp.	4 pp.	8 pp.	16 pp.	COVERS WITH TITLES
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THE AMERICAN JOURNAL OF PHARMACY

VOL. 96.

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EDITORIAL

NAMES—AND NAMES.

"What's in a name?" says Shakespeare. The funny man would probably answer, "If it is a Russian one, the whole alphabet." Seriously, however, the question of names is becoming an important one in the administration of food and drug laws. The misbranding clauses of the Federal and State laws give rise to much discussion as to the limitations or comprehensions of names in familiar use. What, for instance, is meant by "alum"? For many years, the word applied only to the crystallized association of aluminum and potassium sulphates. About the middle of the last century, when the utilization of the ammonia liquors of the gas-works cheapened ammonium sulphate very much, this salt was substituted for the more expensive potassium sulphate, and as the crystalline form and general properties were practically unchanged—alum almost always being used for the aluminum sulphate—the difference of composition was scarcely noticed. The question has recently come up in a legal procedure, which has become of sufficient importance to be the subject of a pamphlet by Dr. A. M. Patterson, Consulting Editor of *Chemical Abstracts*, with a preface by E. J. Crane, Editor of *Chemical Abstracts*.

For information as to the earliest use of any chemical term, we may generally expect aid from that great classic, Kopp's *Geschichte der Chemie*. It appears that the Greeks designated by the word "stypteria" the same material that the Romans called "alumen." Under these names, however, both Romans and Grecians classed all substances that have a distinctly astringent taste. Dioscorides speaks of the substance always as a natural product. As might be expected, aluminum compounds were for a long while confused with iron compounds and no definite conclusion can be drawn as to the

chemical composition of the substances covered by the Latin word "alumen."

Patterson reviews both the ancient and modern literature and comes to the view that chemically "alum" may include any of the series of double sulphates isomorphous with "potash alum" in which the potassium, aluminum and sulphur may be replaced by analogous elements. This is the standard chemical definition of an "alum." A double selenate of rubidium and chromium will, therefore, be an "alum" if it crystallizes in regular octahedra with twenty-four molecules of water, although it contains no element that is in common alum except oxygen and hydrogen.

The question that has given rise to the discussion on the subject is whether sodium aluminum sulphate is "alum." This salt deprived of water is technically known as S. A. S. It is claimed by certain users that it is a mixture of sodium sulphate and aluminum sulphate. Dr. Wiley testified before a Senate Committee in March, 1902, that the basic aluminum sulphate used in baking powders is "neither chemically nor in popular language an alum." Yet in his work on "Foods and Their Adulterations" (1907), he says: "Perhaps by far the largest part of baking powders used contain alum in some form as their constituent." The cynic will probably say with Sheridan: "The quarrel is a very pretty quarrel as it stands; we should only spoil it by trying to explain it."

The question of name has lately come up in another field. What is a "sugar"? The word has really no definite meaning in chemistry. Efforts are now being made to give official sanction to the application of the word (unqualified) to the dextrose obtained by the action of catalysts on starch. It is true that physiologists and pathologists habitually speak of "sugar" in blood and urine, which is usually dextrose, and may be some other carbohydrate but never is sucrose. Yet it would seem that when we come to food products it is a serious question whether any other carbohydrate than sucrose should be allowed the designation "sugar" unless a qualifying adjective clearly indicating source or nature is appended. Physiologists and pathologists are notoriously careless in chemical nomenclature and their practice can have but little bearing on the exact interpretations of chemical terms.

HENRY LEFFMANN.

SELECTED EDITORIAL

THE ALL-PHARMACY HEADQUARTERS FOR AMERICAN PHARMACY.*

In the beginning, last December, of the present campaign for funds to erect and endow a Headquarters Building for the benefit and service of all pharmacy and the public, the undertaking was designated as a campaign for the American Pharmaceutical Association Headquarters Building Fund and the importance of the great enterprise was not recognized nor understood generally, but, within the last few months, a change of viewpoint has rapidly taken place and all classes of drug interests have come to realize the true nature of this project and the undertaking has developed into an all-pharmacy movement, which is defined as a campaign for All-Pharmacy Headquarters Building Fund, which is being obtained and administered under the auspices of the American Pharmaceutical Association, and is truly representative of all phases of pharmaceutical interests, inasmuch as all National and State pharmaceutical associations, under the new reorganization plan adopted at the Asheville Meeting, are entitled to appoint members to the House of Delegates, which formulate and control the policies of the American Pharmaceutical Association. This new conception of the enterprise has already resulted in much good to pharmacy generally and has been largely responsible for the splendid progress which the campaign has made. All classes of drug interests are beginning to realize the practicability of federating their interests, employing their combined influence and power for the good of pharmacy and humanity, through the operations of this Headquarters Building. While many members of our profession realize the importance and value of a museum, library and research department, the large majority understand better the value of a great Publicity Bureau of a National character which will disseminate knowledge to the druggists throughout the country and will develop propaganda to the public of an educational character and will result in a better understanding of the great service which is offered and given by the corner drug store to its patrons. Also, the druggists generally can well understand and appreciate the

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importance of adopting educational measures and other influences which will tend to modify and improve many of the laws and regulations which are imposed upon the practice of their profession, through lack of understanding by those responsible for these laws and regulations, or, possibly, for less justifiable reasons. They also realize that many of these insidious laws and regulations may be eliminated or prevented from becoming laws, when it is proven to those responsible for them that they are unjust and ill-advised. All this and much more will the Headquarters Building accomplish.

As to the present status of the campaign, there is so much to be said that it will be advisable to make as short a statement as possible.

The great drive, beginning about April 10th and lasting some two or three weeks, proved to be only an introduction to the campaign, as was understood by the Campaign Committee. The drive reaped a great harvest, but its greatest accomplishment was to create interest in many states where the organizations had formed, but had not become active. Since the drive, practically every state has reported a number of subscriptions and twenty-eight have reported aggregate subscriptions in excess of \$1000. One state has reported pledges in excess of \$60,000, one in excess of \$30,000, four in excess of \$20,000, three in excess of \$15,000, two in excess of \$10,000, seven in excess of \$5000, ten in excess of \$2000, and many pledges have not yet been reported. The aggregate amount of subscriptions pledged and reported approximate \$275,000 and, in addition to this, there has been reported, but no cards have yet been received, something over \$100,000, so that the aggregate amount pledged, reported and unreported, approximates \$400,000. During the past few weeks our committee has been tremendously stimulated because of several large cash subscriptions which have been made by wealthy individuals, especially one for \$10,000. Our committee believes that many other wealthy men, when they become thoroughly awakened to their great opportunity, will make similar large gifts to endow this great cause. Our business manager has in hand, approximately, \$100,000 in cash and additional payments are rapidly swelling this impressive sum. There is no doubt but that the enterprise will meet with complete success, provided those who have been actively interested in this splendid work will continue their efforts until the full amount, \$1,000,000, is obtained.

H. A. B. DUNNING.

ORIGINAL ARTICLES

THE STORY OF RUBBER.*

By J. W. Sturmer,

Dean of Science, Philadelphia College of Pharmacy and Science.

How old is the New World? How long have the warm, dark jungles of the valley of the Amazon provided a congenial home for amphibians, insects, and the rubber trees? We do not know. Science offers only conjectures. When did the Red Men appear, and when did they learn to milk the "weeping tree," and to appropriate to their use its sticky, milk-white juice? History fails to enlighten us on this point, and again we must acknowledge, we do not know.

We know only that a certain daring Genoese sea-faring man, who, sailing under the flag of Spain, and in search of a westward passage to the spice lands of India, discovered America, and the Red Men—and rubber. He never knew that he had visited a new continent, nor did he realize that the sticky juice which exuded from certain trees felled by his crew was destined to become a commodity of great importance. And when a few years later bouncing balls made from this milk juice were brought to Spain, these were thought of only as a new kind of toy for children. It appears the world, in Columbus' time, was not ready for this great gift of nature, and more than two and a half centuries elapsed before it was seriously investigated with a view to its utilization.

It was Joseph Priestly, then in England, who noticed that it would erase lead pencil marks, an observation which suggested the term "rubber," a name which has endured to this day. The great Michael Faraday subjected rubber to ultimate analysis; but his findings led to nothing of practical importance.

As has been intimated, not the scientists of Europe, but the Indians of South America were the pioneers in discovering use for this jungle product. They employed the milk juice to waterproof their garments; and by drying the juice in a smoky flame, and upon clay molds, they fashioned useful articles, such as bottles, powder flasks, and tobacco pouches. They succeeded also in making waterproof shoes, which in course of time entered commerce in quantity

*One of a Series of Popular Lectures delivered at the Philadelphia College of Pharmacy and Science, 1923-24 Season.

and found ready sale. About a century ago a pair of such "gum shoes" was brought to New England, and within a few years a brisk trade at \$5 a pair had been established for this type of footwear, despite their susceptibility to temperature changes, which was most pronounced, for in cold weather they became hard and brittle, and on warming, as sticky as modern chewing gum, as is the nature of crude rubber or caoutchouc.

A Scotchman by the name of Mackintosh, in 1823, improved upon the waterproofed garment of the Indians by impregnating textile fabric with a solution of crude rubber in a solvent which was virtually impure benzene, and thus was invented the raincoat which to this day is known as a mackintosh.

To be sure, these raincoats, as well as all other crude rubber products, exhibited the same objectionable qualities noted in the South American gum shoes—they hardened in the cold, and got sticky on warming. The stuff was most exasperating, and many attempts were made, both in Europe and in our own country, to overcome the difficulty.

The Problem Is Solved.

One of the early experimenters with rubber was Charles Goodyear. He had been a hardware merchant in Philadelphia, and by chance became interested in life preservers, which in turn drew his attention to the problem of making rubber resistive to temperature changes. He tried nitric acid, but without success. He then purchased a formula involving the incorporation of sulphur and white lead as stiffening agents. As the story goes, he quite naturally resorted to heat as an aid in the mixing, and on one occasion some of the mixture was spilled on the stove, and was accidentally subjected to more prolonged heating than had been intended. Fortunately, Goodyear was an observing experimenter. He noted that the mass which had been exposed to continued heating had acquired new characteristics. This clue he followed with patience and intelligence, finally succeeding in making a product which exhibited remarkable elasticity, and which was not made brittle by cold, or sticky by heat. He had evolved a new substance, a man-made product, superior to the crude rubber of the jungle. The magic wand of Vulcan had under Goodyear's guidance touched and transformed the mixture, and had created a material of boundless possibilities, which was

destined to become as indispensable as steel. *Vulcanizing*, the fundamental process of rubber manufacture, had been invented. It was an epoch-making invention.

Goodyear appreciated the commercial value of his discovery, and about 1839 took out his first patent. A few years later he established in Springfield, Massachusetts, the first factory for the production of vulcanized rubber. Thus was born a new industry which has since assumed billion-dollar proportions, providing literally thousands of articles which have become necessities of modern life. Charles Goodyear and his brother made numerous supplementary discoveries, including a process for the making of hard rubber or ebonite, and was granted as many as sixty patents. The litigation incident to the defense of these patents involved the legal experts of his day, including Daniel Webster and Rufus Choate. Also, they absorbed all of Goodyear's earnings, and he died, as Columbus had died, poor and disappointed. The one had discovered the land of rubber; the other had given us the rubber we can use. Neither gained riches. But the names of both deserve to be linked in connection with the development of a great industry, which has brought affluence to thousands, and has contributed conspicuously to the creature comforts of man, to scientific advancement and to industrial progress.

The Rubber Country.

When Goodyear's new project was gathering momentum, Nathaniel Hawthorne was Surveyor of Customs at Salem, which at that time was a busy seaport. In the old records of its customhouse, one may find in Hawthorne's handwriting various entries covering cargoes of crude rubber. No doubt the sea captains returning from Brazilian ports spun many a strange tale of adventure of rubber gatherers in the South American jungle. Out of these Hawthorne could have built literary masterpieces. He was, however, at that time engrossed in the depicting of New England life, and had no time for "South American Tales—Twice Told." But there is no dearth of literature about the rubber country, nor about rubber gathering, for the explorations in the Amazon valley have, until quite recently, been largely in the interest of rubber. Indeed, in the Amazon region, rubber gatherers are the pioneers, just as the trappers are in the Canadian wilds.

When Theodore Roosevelt in 1914 emerged from the uninhabited stretches watered by the River of Doubt, he encountered, as the outposts of civilization, the camps of the rubber gatherers. A few years before Roosevelt's explorations Algot Lange had accompanied an expedition of rubber prospectors to the head waters of the Amazon, and this writer has given us a most vivid account of the great tropical jungles, peopled only by unclothed savages of cannibalistic



Poling Down to Navigable Water.

habits, and skilled in the use of arrow poison, and in the handling of the deadly blow-gun. He paints the jungle as a most inhospitable region, flooded during the rainy season by the overflowing rivers, whose recorded rise reaches fifty feet or more; a valley which, after the flood-waters recede, quickly greens out with dense and tangled vegetation, through which the traveler must hew his path with a machete—a humid, hot wilderness, where snakes lurk, parrots and parrakeets screech, owls hoot, monkeys chatter, jaguars stalk their prey, and where insect pests abound and make human life a burden.

It is a land of tropical fever and of beri-beri, diseases which annually take their awful toll of human lives, because this region is the habitat of the wild rubber trees, and because rubber for many years has meant much gold.

The fact that the rubber trees of South America are indigenous to low-lying country, flooded annually, gives us the reason for many things which seem strange. It explains why no railroads have been built to tap the wealth of the jungle, why no wagon trails have been blazed through the wilderness, why the outposts of the rubber industry are on the watercourses, why the huts of the gatherers are built on stilts, and why rubber collecting is not a continuous operation, but a matter of annual expeditions. It helps us to more fully appreciate the accounts of explorers. We can understand and give credence to their descriptions: the dankness, the oppressive, humid atmosphere, the prevalence of diseases. We can realize the hazards and hardships of the men who each year steam, then paddle, then pole, for thousands of miles upstream, in order that, nearly a year later, they may lay their contribution of the world's rubber supply upon the wharves of Manaus, or of Pará, whence ships may carry it to European or to North American ports.

Rubber Plantations.

It explains also why rubber plantations came to be, and why these now furnish the major portion of the world's supply of rubber. For the well-nigh insuperable obstacles which nature has put in the path of the gatherer of wild rubber, and the resulting uncertainty of the supply, suggested the plan of transplanting rubber trees to a more salubrious and more accessible region. So about the time of the Philadelphia centennial, an Englishman, Wyckham by name, procured a liberal quantity of the seeds of the most important of the rubber trees of Brazil, namely, of the *Hevea braziliensis*, and shipped his precious cargo to England, for planting in Kew Gardens. When the seedlings had grown to proper size, they were transplanted to Ceylon, a British possession, and were nurtured, pruned, and coddled, just as is done in our country in a nursery with a choice strain of apple trees. And from this, the first rubber plantation, seedlings were procured for extensive plantings by British and Dutch companies, on the various islands which straddle the equator below the

Malay Peninsula, where the climatic conditions have proved favorable, so that at the present time these plantations have grown to cover more than three and one-half million acres, and have come to furnish 92 per cent. of the rubber supply of the world. For it is now cheaper to *grow* rubber than to gather the wild product in the wilderness.

Rubber-Producing Plants.

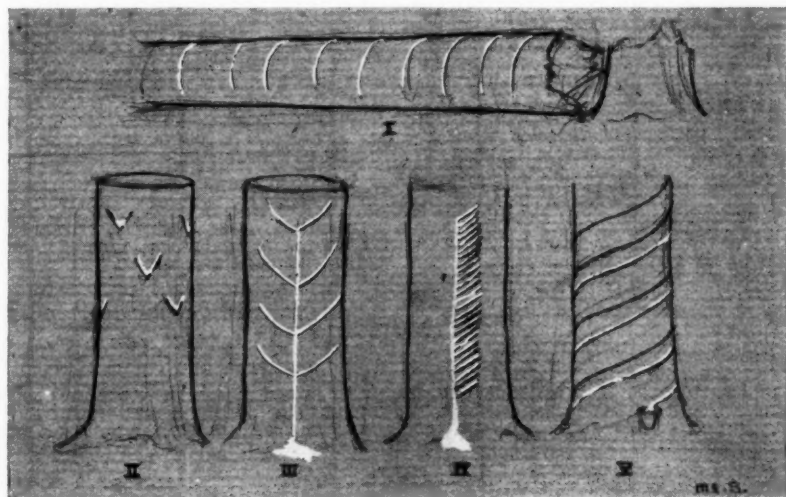
While plantation rubber is obtained almost wholly from one distinct tree, the *Hevea braziliensis*, wild rubber is of divers sources. The wild rubber known in the channels of trade by the Spanish name of *Caucho*, a softer and less valuable product, is obtained from a tree known as *Castilloa Ulei*, which is indigenous to the Amazon region. In the Brazilian state of Ceará several species of *Manihot* are exploited for the so-called Ceará rubber. African rubber, a sticky, ill-smelling mess, is obtained principally from giant creepers of the genus *Landolphia*. It is full of impurities and low in elasticity, yet suitable for certain purposes in rubber manufacture. The chief source of the rubber from Assam, in Asia, is the well-known *Ficus elastica*, cultivated in this country as a house or porch plant. The Mexican rubber, called *guayule*, is obtained from a shrub,—and so on, at great length. Indeed, about a thousand distinct plants are known to possess a rubber-containing milk juice, and some of these are herbaceous and grow in our own country. There is, for example, the milkweed, with which a well-known automobile firm has recently experimented; and it may be that eventually we shall be able to grow our own rubber, just as we now grow our own long-staple cotton, which is the other important commodity for the manufacture of automobile tires.

But at the present time the world's supply of rubber is grown on a comparatively narrow strip—within about 200 miles north and south of the equator—the rubber belt which encircles the earth about its middle. The rubber from the original rubber country enters commerce from the seaport of Pará, on the mouth of the Amazon, or from Manaus, a city located about 1200 miles upstream. But the commercial designation Pará rubber refers at the present time to the product of the wild *Hevea braziliensis*, no matter where collected, or from which port it has been shipped. It is used also in a more general way for any kind of hard crude rubber of good quality. The

plantation rubber, though from the same botanical source, is not precisely identical with wild Pará, of which, it may be mentioned, there are several grades; but the difference was more pronounced some years ago than at present.

Tapping the Rubber Tree.

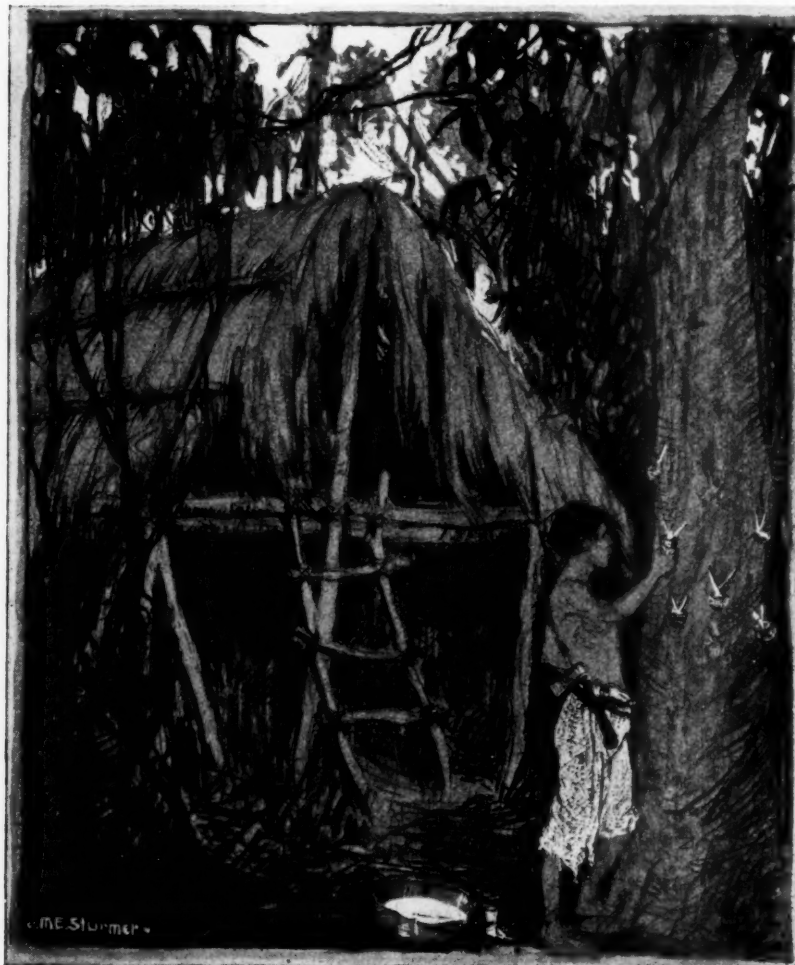
The tapping of the rubber tree is done variously. There are as many methods as there are ways of skinning a cat. The South American tapper cuts a V with a hatchet-like tool, and collects the milk-juice or latex in a small cup of tin or of clay at the point of the milk-juice or latex in a small cup of tin or of clay at the point of the V.



Various Ways of Incising the Bark.

In some localities the herring-bone incisions are in vogue. But on the rubber plantations tapping has been reduced to an art. A small, razor-sharp knife is employed, and only about one-twentieth of an inch of bark is removed at each cutting along a diagonally-cut channel. The gatherer of wild rubber taps from seventy-five to one hundred trees a day, following the paths which he has previously cut through the jungle, and which constitute a number of loops radiating from a watercourse, or from a path to the camp. On the plantations, however, where trees grow in orderly rows, about 110

to the acre, 400 or more trees are visited by a single gatherer. The latex, or milk-juice, is not the sap of the tree, but courses through tubes in the inner bark, running mainly up and down, but connected,

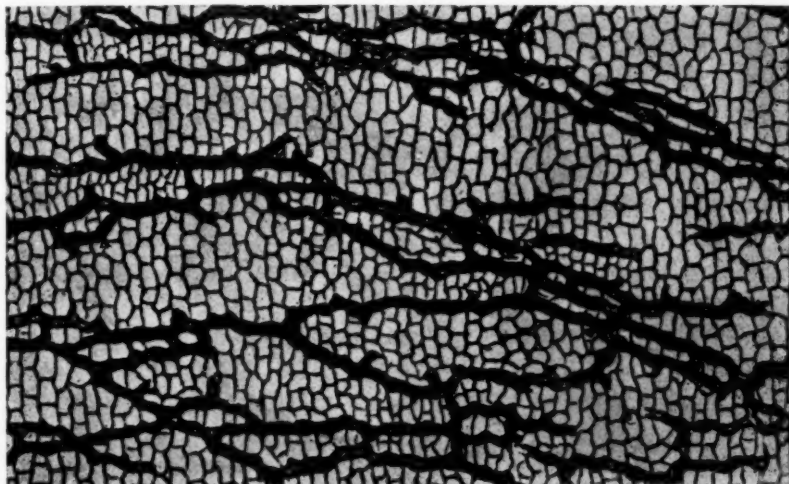


In Tapping Wild Rubber Trees, the Main Object Frequently is to Get All the Tree Will Yield.

one with the other, like canals in Holland. Great care must be observed lest the cut enter the wood, which would lead to contamination of the latex with sap, and would cause injury to the tree.

The Latex.

The latex which exudes is milk-white, or nearly so, and on exposure to air coagulates, just as does blood from a cut, plugs the wound, and prevents bacterial or mold infections. Moreover, any insect attempting to enter the wound would come to grief. It appears, therefore, to the biologist that the latex serves an important purpose in the struggle for existence to which the rubber tree is subjected in its natural habitat, where the humidity and temperature are high, and the conditions are favorable to the growth of micro-organisms.



Latex Tubes in a Milk-Juice Yielding Plant.

The latex is an emulsion-like suspension resembling cream in general appearance. Under the microscope it shows particles from .0006 inch to .003 inch in diameter, dispersed through a watery fluid, exactly like the butter-fat is suspended in milk or cream. Hence the term *latex*, from *lac*, which is Latin for milk.

About one-third of the latex is rubber. There is present also about 1.65 per cent. of resinous matter. And in the aqueous liquid, in which the rubber and the resin globules are suspended, there is found in solution about 2 per cent. of protein, and about 7 per cent. of mineral matter. When the tree has been tapped, the latex flows

for about an hour, the average yield being approximately an ounce, though it varies naturally, with the size and age of the tree. The tree in the jungle is usually tapped daily; on the plantations, however, it has been found advantageous to tap on alternating days, or on the third day. The planters obtain an annual yield per tree of about three pounds of raw rubber, or about 350 pounds per acre. This means that on an average, two trees bleed for an entire season to provide the rubber for one Ford tire. But as there are about three and a half million acres in rubber plantations, with about 110 trees to the acre, to say nothing of the wild rubber from South and Central America, it appears that for the present there is no danger of a dearth of this modern necessity.

Coagulation.

If rubber latex is allowed to stand, it undergoes spoiling, just as does cow's milk. It thickens, becomes discolored, and gives off an offensive odor, due to the putrefaction of the nitrogenous matter. It is important, therefore, that it be coagulated as promptly as possible. The South American native accomplishes this result by drying the latex over a smoky flame. His routine is as follows: In the early morning he makes the rounds along his paths through the jungle, notching the trees, and attaching the little cups to catch the exudate. Some hours later he makes a second trip, emptying the milk-juice out of the cups into a bucket. When he has returned to camp, with the product of probably seventy-five to one hundred trees, and his fellow-workers have brought in their supply, a fire is built, and is fed with wood and palm nuts until it produces a dense, acrid smoke. A cone of burnt clay is placed over the fire to concentrate and direct the smoke. A paddle is now heated, dipped into the latex, and held into the smoke until the latex has hardened on the paddle. The operation is repeated again and again, until there has been built up on the paddle, layer by layer, a mass weighing from forty to seventy pounds. The smoked and hardened latex is proof against spoiling, is, in fact, raw rubber. The heat evaporates most of the water and causes also certain chemical changes, in which effect it is aided by the acetic acid in the smoke, while the phenolic constituents of the latter play their part in the preservation. The rubber, darkened more or less by chemical alteration of certain constituents

of the latex, and to some degree also by soot, smells like a smoked ham, and is ready for shipment. It is the Up-river Pará rubber of commerce.



Smoking Latex.

But there are many other methods of coagulation. In some localities the latex is allowed to run down the tree and to solidify. It is then pulled off in form of threads and compressed into balls. The latex from species of *Castilloa* is coagulated by means of the juice of a plant, namely, of *Ipomœa bona-nox*. The product is the

raw rubber known as caucho. Alum, tannin, soap, lye, certain acids, and also salt are similarly employed. It appears that any substance capable of coagulating albuminous matter will serve the purpose, for it will alter the protein in the latex which acts as a protective colloid surrounding the rubber globules in the emulsion-like liquid. On the rubber plantations, where the process of coagulation has been subjected to scientific study, a weak solution of acetic acid is the coagulant in general use. The latex is poured into a large tank, or into stone jars, and the diluted acetic is added, together with some solution of sodium bisulphite, to prevent the production of a purple coloring matter, which may form in the latex because of certain enzyme action, and which would discolor the raw rubber. The coagulum forms gradually, and when the process has progressed to the right point, the resulting mass is passed through a masticating machine, and then between rollers to press out the excess of water. Next it is washed in clean water, again passed between rollers, and the resulting sheets are hung up to dry. By this procedure is made the "pale crepe" of commerce. Or the sodium bisulphite may be omitted, the washing in fresh water also, and the sheets, as they are received from the rollers, hung up in a large smokehouse and very carefully subjected to the smoking process. "Smoked sheets," which is the commercial name for this type of raw rubber, are usually ribbed, a result effected by using rollers with corrugations. As is well known, raw rubber sheets adhere, and the ribbed surfaces are produced to reduce this adhesion to a minimum, so that the sheets may readily be pulled apart.

But a recent development in the rubber industry eliminates the coagulation process entirely, and the fresh latex, preserved by means of ammonia water, is now being shipped direct from the plantations to the factory, where it is reduced to a solid by dropping it in a thin stream upon a rapidly revolving disc, an operation which is conducted in a heated room. By this means the latex is converted into a fine spray, from which the water evaporates, the rubber being obtained in the form of minute solid particles. As compounding ingredients, in the form of suspensions, may be poured upon the revolving disc and be atomized at the same time, an intimate mixture of such substances and raw rubber is readily obtained, and the laborious task of softening the dry raw rubber by kneading it between hot rollers, and working in the compounding agents in form of

powder, is thus made unnecessary, and the danger of imperfect mixing is avoided.

Raw rubber, whether from the wilds of South or Central America, or of Africa, or from the plantations, whether obtained by one coagulation process or another, whether the product of the Hevea, or a *Castilloa*, or of *Ficus elastica*, or of the giant vines and creepers in the region of the Congo, is but raw material for the manufacturer. And when, in this country, we speak of the rubber industry we do not refer to rubber tree culture, or to collecting, or coagulating, but to the production of articles into which raw rubber enters. Of these there are many thousands. In some, as in rubber bands, elasticity is the quality particularly desired. In others, the impenetrability of rubber to liquids or to gases is the reason for its use. In electrical appliances rubber serves as a dielectric or non-conductor. The resiliency of rubber and its resistance to abrasion are valuable properties. Crude rubber, however, varies in chemical composition, and consequently also in its properties. Accordingly the manufacture of goods made of rubber involves many problems. But the fundamental problems were solved by Goodyear, though his process has in recent years undergone marked improvement, the result of scientific investigation, and of patient experimentation, conducted in a more or less empiric manner.

A Bit of Chemistry.

But what, chemically speaking, is raw rubber? We find that it is essentially a hydrocarbon, a compound of carbon and of hydrogen, with the ratio of five atoms of the former to eight of the latter—the same elements, and the same proportions, which we find also in certain constituents of volatile oils. The molecule is unsaturated, and can additively combine with sulphur, or chlorine, and with certain other elements. The chemical formula C_5H_8 does not, however, indicate the size of the molecule, which is still undetermined. Hence, the formula for the rubber hydrocarbon is usually written $(C_5H_8)_n$, in which case n stands for the undetermined number.

It is not known how many C_5H_8 groups are linked together in the rubber hydrocarbon, for the methods generally employed to determine the relative weight of molecules are not applicable in this

case, as the substance cannot be vaporized and cannot be dissolved to a true solution. Stating the case in chemical terms, we know the rubber hydrocarbon to be a "polymer" of C_5H_8 , but we do not know the degree to which polymerization has progressed. There is evidence, furthermore, pointing to a difference in the degree of polymerization in the different types of raw rubber. It is generally believed, also, that heat operates to de-polymerize—to form a lower polymer—while the chemical action incident to vulcanization tends to enhance it. When we consider now that the resins, the proteins, and other substances which are associated with the rubber hydrocarbon in the crude product vary in kind and in quantity, we get an inkling of the complexity of the problems which confront the rubber chemist.

There has been accumulated, however, a great wealth of facts about rubber—some chemical, others physical—and as a consequence much of the empiricism of rubber manufacture has given way to scientific procedure, and the products have been improved marvelously.

Let us return now to the epoch-making discovery of Goodyear—to the process of vulcanization. The rubber hydrocarbon being unsaturated, actually takes up and combines chemically with sulphur, and without the displacement of any of its hydrogen. A solid, of the general composition $(C_5H_8S)_n$, is actually known, and no doubt constitutes a considerable portion of hard rubber or ebonite. But some of the sulphur in commercial rubber products is always present in the free state, and may be extracted by acetone or other suitable solvents, this being true for soft rubber, in which the sulphur used in the vulcanization is low in quantity, as well as for ebonite, in the manufacture of which a large amount of sulphur is employed. Indeed, the microscope discloses sulphur crystals in the vulcanized rubber, and many commercial rubber products are actually covered with a "bloom" which consists of sulphur. [The bloom must not be confused with the dusting powder which is talc, and which serves to prevent adhesion of rubber surfaces.]

What has been said of raw rubber may be repeated in connection with the vulcanized material, namely that many problems remain unsolved. True, much has been learned since Goodyear's day, and the process is now subject to scientific control; but when it comes to the chemical explanations of the results obtained, there is a marked diversity of conclusions. To what extent is the change in

physical properties due to the formation of the sulphur compound? Does adsorption of sulphur play a part? And to what degree is the transformation due to the production of higher polymers of the hydrocarbon? Investigators are working on these problems and upon related ones.

Accelerators.

When sulphur and raw rubber are mixed, and the mixture kept, the changes due to vulcanization take place, though so slowly as to be practically unnoticeable. Heating speeds up the process. So does the presence of certain other substances, which are presumed to act catalytically. The impurities in raw rubber, the proteins particularly, appear to act in this manner. But the quantity present in crude rubber is small, and in the different kinds of crude rubber is quite variable. Hence it has become the custom to add catalytic agents, usually nitrogen compounds capable of acting as sulphur-carriers, that is, compounds which readily take on sulphur, and readily lose it, particularly in the presence of substances which have developed an avidity for this element. In the rubber industry such compounds which serve to speed up vulcanization are called accelerators. Of these the list is large. But only a small number have stood the test of practical procedure. Some are too expensive. Some volatilize at too low a temperature, their vapor causing the rubber to rise like dough, and to become spongy. Others are too poisonous. But certain compounds of aniline such as thiocarbanilid, or hexamethylene tetramine, or aniline itself, are used in great quantity, and it is a safe statement that all American manufacturers now use organic accelerators. It has been observed, also, that certain accelerators work best in the presence of certain mineral substances, which serve to accelerate the accelerator. Zinc oxide, calcium oxide, magnesium oxide, and in some cases lead oxide, are employed in this capacity. The advent of accelerators has cut in half the time of vulcanization, reduced manufacturing costs, and has doubled the mechanical strength of soft rubber. It is one of the reasons why our tires now run longer.

The Effect of Vulcanization.

Goodyear observed that his new product was not softened and made tacky by heat, and brittle by cold, and that its elasticity had been increased. But vulcanized rubber differs from raw rubber also

in its behavior towards solvents. The higher the degree of vulcanization, the more marked is this difference, and solutions of rubber in carbon disulphide, benzene, gasoline, etc. are made with raw rubber. The first step is a swelling of the rubber, which is accounted for by assuming a sort of honeycomb structure of the solid. The solvent fills the cavities and distends them, giving rise to the gel formation. The time factor is important, and different raw rubbers, as well as partially vulcanized products, differ in the time required for maximum distention. When this has been effected, shaking breaks up the gel, and disperses it through the excess of the solvent, producing a colloidal solution. Masticated or milled rubber forms such a solution more readily than the natural substance. It should be remembered in this connection that rubber solvents do swell and deteriorate soft rubber goods, such as tire treads and tubing. Rubber products should be protected against such solvents and also against oils, which have a softening effect.

The process of vulcanization is gradual, progressing by imperceptible stages. The result is a matter of amount of sulphur used, temperature, accelerators, and the duration. In practice the procedure is continued to the point where the product has acquired the physical properties desired, particularly the property of stretching to a high degree and of resistance to breaking when it is being stretched. The testing machine used pulls a piece of the rubber—a piece of certain standard dimensions—recording the elongation, and the pounds of “pull” exerted. As the piece of rubber lengthens, it resists further lengthening more and more, and more power is required. Finally the rubber breaks, and the pull necessary to accomplish this gives us the “breaking point.” It is by physical tests such as these rather than by chemical analysis that the manufacturer scientifically controls the vulcanization. But the chemist plays an important role notwithstanding.

Rubber Compounding.

A tire tread made to contain nothing besides rubber and the proper amount of sulphur would, upon vulcanization to the point of maximum stretch, be too soft, and would not be sufficiently resistive to abrasion. To make the finished product of adequate firmness it is necessary to incorporate solid material which has a reinforcing

effect. Of such substances, of which a great variety are in use, carbon black and zinc oxide are among the best, in part because of their extreme fineness of subdivision, the average size of a particle of carbon black being but a tenth of a micron in diameter, and that of zinc oxide of proper quality about one micron, that is to say, about $1/25,000$ of an inch. Extraordinary vitality has been imparted to tires and to other rubber products by the judicious use of mineral re-enforcing materials, which are selected with reference not alone to their fineness of subdivision, but also to their thermal conductivity, their opacity (retarding "sun-crack"), their color, their specific gravity, their inertness chemically, their cost, etc. Fine clays, lithopone, whiting, diatomaceous earth, barium sulphate, are used in great quantities.

There is also a long list of pigments and dyes in the stockroom of the rubber manufacturer, the pigments serving in some cases in the capacity of reinforcing agents or as mere fillers. Ferric oxide, lead sulphide, prussian blue, ultramarine, golden sulphide of antimony, chrome green, the ochres, are popular pigments. And as to dyes, these are synthetic compounds, popularly known as coal-tar dyes, and must, naturally, be oil-soluble, and not water-soluble. Toy balloons, and other playthings of rubber, druggists' rubber articles, and even footwear and clothing, are dyed, or are tinted with pigments. We have then in a rubber mixture, ready for vulcanizing, rubber, sulphur, an accelerator, a mineral substance to accelerate the accelerator, re-enforcing material—or only filler, where strength is not a primary consideration—and possibly pigments or dyes. What else may there be? Let us see.

Reclaimed Rubber.

Why does the junk man buy old tires, old rubbers, old garden hose? This junk goes to the reclaiming factory, where it is worked up into a product known as *reclaimed rubber*, millions of pounds of which are used annually. Indeed, about one-fifth of the rubber consumed in our factories is reclaimed rubber, though, to be sure, its use is limited to the production of certain types of rubber products, as, for example, shoe heels and soles. While its cost is far below that of crude rubber, its popularity is not primarily dependent upon this fact, for it possesses certain desirable qualities, works up

easily on the mixing rollers, and facilitates the incorporation of mineral fillers and re-enforcing agents. It serves a purpose, and is not a mere cheapening agent.

The first industrial process for reclaiming rubber was invented by Chapman Mitchell, of Philadelphia, a brother of Dr. S. Weir Mitchell. It consisted essentially in hydrolysing the cotton of the rubber waste by means of sulphuric acid. But at present the alkali process, patented by Marks, is in general use, for the acid failed to remove the uncombined sulphur, while the sodium hydroxide solution, at the high temperature employed—about 350 degrees F.—combines with this element, and makes it water-soluble.

Softening Ingredients.

As has been stated, crude rubber, on being worked between rollers, softens and develops tackiness. To what extent this change is caused by the rupture of the coating of protective colloid—the protein of the latex—and to what extent it is due to de-polymerization of the rubber hydrocarbon by the heat engendered during the manipulation, one cannot say. Anyway, this plastic condition must be achieved in order that the mineral compounding agents may be incorporated. As Pará rubber, plantation crêpe or sheets are plasticized with difficulty, not only soft natural rubbers, like the African product, and reclaimed rubber, may be employed in the formula, but also certain asphaltic residues of western petroleum (sometimes called mineral rubber), coal tar or pitch, pine tar, paraffinic, petrolatum-like materials, and fatty oils of vegetable origin, serve a definite purpose in making the “mix” for certain types of rubber products.

This, in general terms, gives us an idea of the composition of manufactured rubber articles—rubber, sulphur, accelerator, metallic base, reinforcing powders, mere fillers, pigments, dyes, reclaimed rubber, softening agents. Out of these the rubber chemist chooses the ingredients which will yield a vulcanized product possessing the specific properties required.

The Art of Compounding.

The art of compounding was formerly a matter of the utmost secrecy in the rubber factory. No stranger was permitted a glance into the mixing room. Not even connection with an educational institution served as an “open sesame.” One entered an anteroom

and looked through a little hole or window just large enough to frame a human face, humbly asked for permission to see "the works," and was shown into the shipping department. In those days compounding was largely a matter of rule of thumb methods. Certain substances were used and brought about certain results. No one knew clearly how or why. The manufacturer was inclined to believe he had trade secrets which his competitors were trying to steal. But at the present time our chemical journals carry numerous reports of researches on rubber; the industry has, indeed, periodicals devoted to its own interests, and there are a number of textbooks on this branch of industrial chemistry. Secrecy has, speaking generally, given way to a more liberal policy. There are, to be sure, trade secrets, as there are in many other lines of manufacturing. But a visitor provided with proper credentials is now accorded a most courteous welcome and is permitted a glimpse into the mysteries.

Let us ask our guide some questions and make note of the information he so willingly provides. Here are a few memoranda:

Elastic Bands.—Pará rubber, 5 to 6 per cent. of sulphur, and accelerators. No compounding ingredients. Rubber tubing, sheeting, etc. characterized by the term "pure gum," have the same composition. We have in such products great elasticity and high resistance to breaking, but not sufficient firmness to withstand abrasion.

[Bands are cut from tubing on a machine built on the plan of a guillotine. Wet rubber may be cut readily. Even a wet knife will readily cut rubber tubing.]

Dentists' Rubber Dam.—Pará rubber, vulcanized in vapor of sulphur chloride, S_2Cl_2 , which forms an additive compound with the sulphur hydrocarbon, just as elementary sulphur does.

Surgeons' Gloves.—Made from rubber cement, which is raw rubber dissolved to a colloidal solution in gasoline. Made by dipping porcelain molds repeatedly (five to ten times) into the cement, to obtain adequate thickness. After drying the glove is vulcanized in vapor of sulphur chloride, or is dipped into a solution of this chemical (2-4 per cent. strong) in carbon disulphide.

Bathing Caps.—Pará rubber, 75 to nearly 90 per cent., about 5 per cent. of sulphur, about 5 per cent. of oil for softening, some accelerators, dyes, and pigments. White bathing caps may contain nearly 20 per cent. of zinc oxide, which also improves the strength of the products.

Air Cushions.—Pará rubber about 50 per cent., sulphur $1\frac{1}{2}$ to 2 per cent., and zinc oxide, and filler, which may be whiting or may be a filler which imparts color.

Bulbs.—Pará rubber, about 45 per cent., 6 to 8 per cent. of sulphur, zinc oxide and whiting for white bulbs; zinc oxide, whiting, and carbon black for black bulbs. The latter may also contain lead compounds, which in the vulcanizing forms black lead sulphide.

Hot Water Bottles and Similar Articles.—Rubber, various grades, 20-30 per cent., about 2 per cent. of sulphur, zinc oxide, whiting, white clay, in some cases some rubber substitute. Golden sulphuret of antimony may replace the sulphur in goods of tan or reddish-brown color. Various pigments and dyes for special colors. A variety of grades of these goods are manufactured. The sulphur content is kept low to prevent "bloom."

Rubber Sponge.—Pará rubber, varying proportion, some oil, or oil and wax, to soften, some filler, which in cheap sponges may exceed 50 per cent., and some ammonium carbonate (about 8 per cent.), incorporated, to decompose during the vulcanization, and to produce carbon dioxide and ammonia gas, these gases causing the rubber dough to "rise" and to become porous, just as carbon dioxide, from baking powder or yeast, gives lightness and porosity to bread or cake dough. The rubber sponge of average grade contains about 25 per cent. of rubber. It may also contain some "white substitute," described under Rubber Erasers.

Rubber Tubing.—A variety of kinds and grades are made. The tubing may be made of Pará rubber and sulphur (about 5 per cent.) with accelerators, but no reinforcing or filling material. This variety is known as pure gum tubing. Or it may be made to contain as much as 50 per cent. of zinc oxide as reinforcing material.

This does not cheapen the product, for zinc oxide of the quality used costs more volume for volume than the raw rubber. It is added to produce a firmer product. Cheaper white tubing is made from lower grade raw rubber, with additions of rubber substitute and mineral filler, such as whiting, with probably a little vegetable oil to facilitate the incorporation of large quantity of dry material. Barium sulphate is employed largely as filler in cheap rubber products, particularly if the "rubbery feel" is not to be lost. Cheap tubing contains about 15 per cent. of rubber.

Rubber Stoppers.—These also may be of the pure gum variety with no reinforcing ingredients or filler. Common rubber stoppers, if white in color, contain zinc oxide, clay and whiting; sometimes rubber substitute, with a little vegetable oil. Wringer roll dust may be incorporated. There may be as little as 10 per cent. of new raw rubber used in the mixture. Black stoppers may contain reclaimed rubber, carbon black, and lead compounds, which are converted into lead sulphide. The average amount of new rubber used is about 30 per cent.

It may be of interest to students that holes may be bored in rubber stoppers with a common cork borer, wet with sodium hydroxide solution, or even with water.

Pencil Erasers.—Pumice stone (about 10 per cent.) is added to impart abrasive quality, and "white substitute" to reduce cohesion between the rubber particles, so that after vulcanization the product is soft, wears away when used and does not unnecessarily roughen the paper. Zinc oxide is used to some extent; so also are whiting and various pigments. Ink erasers contain more pumice, and this in a coarser powder, and in some there is finely ground glass. ("Substitute" is made by boiling corn oil with sulphur. The product may be vulcanized, yielding "white substitute.")

Rubbers.—Black being the most popular color, the rubbers have for years been made from composition containing litharge, or other lead compounds, which in the vulcanizing produce black lead sul-

phide. At the present time, however, carbon black is the popular reinforcing material to raise the stress-strain curve, and at the same time to act as a black pigment practically impervious to light, thus retarding "sun crack," so frequently noticed in the rubbers of yesterday. The rubber composition for the uppers is different from that of the sole; but speaking generally, whiting, strange to say, or china clay, are common fillers for rubber footwear composition. Reclaimed rubber is used to a considerable extent, particularly in soles, the higher grades of which may contain as much reclaimed as new rubber, and the cheaper grades considerably more. Asphaltum and asphaltic petroleum residue may be used to some degree.

Rubber Heels.—The composition is similar to that for soles. But finely ground fibre of cotton, wool, linen, etc., is usually included.

Pneumatic Tires.—The tread is made particularly tough and firm, yet with a high stress-strain curve. A few years ago some manufacturers made white treads with zinc oxide as reinforcing material. At present the tread of all standard makes is black in color, carbon black having been found more efficient. There may be present also a little litharge, or magnesium oxide, and a little tar or oil to facilitate the incorporation of the carbon black which is used in the ratio of about twenty to thirty pounds to a hundred pounds of raw rubber. In cheap tires the tread may contain clay as filler.

The side walls of the tire may contain a mixture of Pará rubber (for strength) with softer rubber like caucho. Over-vulcanizing must be avoided lest the tire age quickly. Carbon black, 10-25 per cent., zinc oxide, etc. are employed for reinforcing. The frictioning used on the fabric or cord serves as a lubricant, so that the threads in the repeated flexing of the tire do not wear against each other. It is much softer than the tread, and is made of a mixture of raw rubber, usually including Caucho or African, as well as some Pará rubber. Zinc oxide and the usual vulcanizing materials complete the formula.

Inner tubes may be of the same composition as rubber bands—

about 93 per cent. rubber. Or they may contain a small amount of zinc oxide. The red tubes may have been vulcanized with golden sulphuret of antimony.

Rubber Belting.—Usually made of soft raw rubber, with litharge, barium sulphate, and whiting. It contains about 8 per cent. of sulphur, and from 35-40 per cent. of rubber. In the rubber covering compound reclaimed rubber may be used.

Rubber Matting.—Soft raw rubber, reclaimed rubber, whiting, clay and other mineral filler, lead compounds (for color) and zinc oxide. But a more durable product is now made from Pará or plantation rubber, carbon black as reinforcing agent, and a small amount of mineral filler.

Hose.—The difference between hose and tubing is that the former is built up of cotton fabric "frictioned" with a rubber composition similar to that used in pneumatic tires, while tubing contains no fabric. For cheap hose a great deal of reclaimed rubber, rubber substitute, and mineral filler is used, and only a relatively small amount of new raw rubber. But the composition of the rubber covering is devised to yield a product which will resist abrasion, and is much tougher than the frictioning which covers the individual layers of fabric.

Hard Rubber.—For such articles as combs, Pará or plantation rubber, and sulphur, in nearly equal quantities, are employed together with appropriate pigments. For syringe pipes the sulphur content is lower—about 30 per cent.

Storage Batteries.—Raw rubber, balata, black substitute, clay and sulphur (about 15 per cent.).

In all kinds of hard rubber products hard rubber dust may be utilized, together with mineral filler and pigments.

The Branches of the Rubber Industry.

The rubber industry of America manufactures some fifty-odd thousand separate articles. But specialization has been carried to a considerable extent, and in some factories only a single line of rub-

ber goods is produced. There is, for example, the hard rubber industry, with its subdivision of electrical supplies, battery cells, and toilet articles, such as combs, brush handles, etc. And, speaking of soft rubber, the manufacture of belting, packing, matting, hose of all kinds, insulated wire, has grown to great proportions. Druggists' sundries, surgeons' and stationers' supplies, household articles, toys, too numerous to mention, are made in great quantity. Dentists' material and rubber stamps have become necessities. Rubberized cloth is made for various uses. The footwear business has grown to an astonishing degree, and a pair of rubbers is made annually for more than 75 per cent. of the population of the United States, while nearly 50 per cent. of all the men, women and children now walk on rubber heels. Tennis shoes, golf balls, and other goods of rubber play an important role in sports. But the greatest department of the rubber industry has to do with the manufacture of tires. This country imports two-thirds of the entire rubber crop of the world; and about three-fourths of this immense quantity goes into tires—pneumatic tires, solid tires—tires for trucks, tires for baby carriages, tires for bicycles, but above all else, tires for automobiles, of which about fifty million are now made in a year.

The Machinery in the Rubber Industry.

To tell the story, even in outline, of the mechanical features of mass production processes in these various lines is precluded by the limitations of time—and of space—when this lecture goes to the printer. It's "another story," as Kipling says, one which deserves to be told by aid of a "movie film." But we might, in conclusion, take a mere peep into one of the great factories of Akron, which is the chief center of rubber manufacturing in the world. The first step in all rubber manufacture consists in plasticizing the raw rubber, in order that the compounding ingredients may be incorporated. This is done usually by the aid of a machine constructed on the general principle of a clothes wringer. But the rollers rotate against each other at different speeds, thus producing a grinding or wiping effect. In case of wild rubber, impurities are to be removed. This is done on a mill of special type, having hollow rollers which may be heated with steam, or, later in the operation, cooled with water. A stream of water is made to play upon the rubber as it revolves, wrapped about the rollers. The washroom is a messy,

noisy place, and, when African rubber is being washed, is an offense to the nostrils. After the washing, the rubber must be dried, which is frequently accomplished *in vacuo*. Plantation rubber, however, does not require washing, and goes direct to the mixing mill, which is similar in construction to the mill previously described. The friction and the heat produced as the rubber is chewed by the rollers revolving at different speed makes it plastic, so that compounding ingredients may be worked in. The operator shovels the dry powder upon the rubber as it enters between the rollers, and the machine does the rest. The resulting rubber mixture resembles putty or stiff bread dough in consistency, and is now ready for shaping. It may be spread upon textile fabric, may be rolled out into sheets, or passed through a "tubing machine," or molded, although, to be sure, the composition and hence the physical properties of the mass are made to vary in accordance with the subsequent steps of manufacture contemplated. Raw rubber, and, particularly, plasticized rubber, is adhesive. So a tire, or a rubber shoe, may readily be built up over a form without the use of much cement.

The final step of the processing is the vulcanization. This procedure differs materially with the nature of the articles to be "cured." A tire, for example, is enclosed in a metal form, called a pressure mold, for within the tire there is placed an airbag, which is essentially a strong inner tube, and this is inflated, so that the tire presses firmly against the inner walls of the mold. Rubber shoes are also made largely in pressure molds, though some firms still vulcanize footwear on racks in closed, heated compartments. A vulcanizer for tires is a large, tubular compartment, holding twenty-odd tires, and capable of being closed airtight.

The machinery needed to mix the rubber composition, to do the shaping, to facilitate the assembling, and to convey the materials, the partly finished, and the wholly finished articles, hither and thither, until they finally land in the shipping room, is in itself a worthy text for a story. We wonder what Charles Goodyear would say to all this—or the crew of Columbus, who knew of nothing that could be done with caoutchouc, except to bounce it. And now we are beginning to use rubber for paving blocks.

What in fact is the future of the rubber industry? Its possibilities stagger the imagination. We are entering, as Dr. Greer says, upon the "Reign of Rubber."

THE EVOLUTION OF CHEMICAL TERMINOLOGY. VIII. TOXIN.

By James Fitton Couch.

"Seeing that truth consisteth in the right ordering of names in our affirmations, a man that seeketh precise truth had need to remember what every name he useth stands for, and to place it accordingly; or else he will find himself entangled in words as a bird in limetwigs—the more he struggles, the more belimed. Words are wise men's counters—they do but reckon by them; but they are the money of fools, that value them by the authority of an Aristotle, a Cicero, a Thomas, or any other doctor whatsoever."—HOBBS.

The present use of the term "toxin" does not restrict it to any one specific concept but rather involves several related ideas differing in extension of meaning. The term is used in special ways by scientists in different fields of activity so that to the bacteriologist it may have a different connotation from that which it has to the phytochemist or to the zoologist. There seems to be no general agreement among scientists, even of the same group, as to the precise logical area governed by this term and the question of its relation to such other terms as toxalbumin, venom, phasine, enzyme, and ptomaine is quite unsettled. The broadest use of the term includes all poisonous substances; the most limited use confines it to those bacterial toxins that stimulate the formation of antitoxins.¹⁰ In between are the various ill-defined meanings attached to the term by men of different interests. Some use the word to denote any poisonous substance of animal or vegetable origin; others apply it only to complex organic poisons of undetermined composition; many restrict the term to those substances that closely resemble the bacterial toxins, the zootoxins represented by the snake venoms, the phytotoxins, represented by the toxalbumins, ricin, abrin, and the phasines.

The lack of specific meaning in the common usage of the term is reflected in the definitions presented by dictionaries. While "Webster's" restricts the term "toxin" rigidly to those substances produced by micro-organisms and characterized by power to provoke antitoxin formation, it curiously defines "toxine" as synonymous with ptomaine. The "Century" is nearly as limited: "A toxic albumin or ptomaine; a poison produced in animal tissues by the action of micro-organisms." "Funk & Wagnall's" is broader: "Any of a class of poisonous compounds of animal, bacterial, and vegetable origin. . . . 2. Any poisonous ptomain." This definition lets down the bars to

all but mineral and synthetic poisons. "Dorland"⁵ defines toxin: "1. Any poisonous albumin produced by bacterial action. . . . 2. A poisonous base formed by bacterial action, a ptomaine." At the same time he makes toxalbumin a general term which includes toxin: "Toxalbumin: Any poisonous albumin, whether of bacterial or other origin."

That the common conception of the word toxin does not coincide with any narrowly restricted definition is demonstrated by the scores of terms derived from the Greek *toxikon* that refer to poisoning by any toxic agent regardless of its composition and chemical relationships. Such are the terms toxic, toxicant, toxicide, atoxic, toxicity, toxicoderma, toxicoid, toxicology, toxiferous, toxicosis, toxinfection. Yet there is a number of terms derived from *toxikon* which are strictly limited to poisoning by bacterial toxins, as toxemia, toxigenic, toxoid, toxolysin, toxon, and toxozoin.

The word toxin came into chemical literature in 1812 when Boullay¹ used it to form the word *microtoxine*: ". . . j'ai préféré désigner à la fois sa saveur et sa qualité vénéneuse; l'expression de *microtoxine* (Du grec *picros*, amer, et *toxicon*, poison) que je soumetts au jugement des savans . . ." Following this precedent many similar terms were coined, all of which are familiar to phytochemists and pharmacologists; among these digitoxin, cicutoxin, sapotoxin, tubatoxin, podophyllotoxin, and scillitoxin may be referred to. The unmodified term toxin appears to have been first used by Brieger in 1886 who applied it to the toxic ptomaines that were then considered the poisons in bacterial diseases. "Zur näheren Characterisirung der giftigen Ptomaine gestatte ich mir die Bezeichnung Toxine zu gebrauchen."⁴ Three years previously Brieger had coined the term "peptotoxin" for a toxic ptomaine that he had isolated from decaying protein material.² At that same period he was referring to the ptomaines as "Fäulnissalkaloide."³

Four years after Brieger had restricted the term toxin to the poisonous ptomaines Lankester⁷ used the term to indicate the bacterial poisons without stating the probable chemical nature of these substances. Vaughan and Novy in 1896⁸ referred to the term in this way: "Brieger restricts the term ptomaine to the non-poisonous basic products and designates the poisonous ones as 'toxins,'" page 16, and, "We do not as yet know enough about the physiologic or toxicologic action of the putrefactive alkaloids to render the classification proposed by Brieger worthy of general adoption. Besides,

this term toxin is now quite generally, although somewhat incorrectly, employed to designate those non-basic bacterial poisons for which Brieger suggested the name toxalbumin." (P. 17.) They further state, "As everyone knows, the word toxin simply means a poison, and all poisons are toxins." (P. 24.)

These quotations illustrate the lack of uniformity in the present use of the term and the desirability of a remedy. The proper action is, however, not apparent. Whether we agree to restrict the application of the term to bacterial products of definite characters or extend it to include substances that cannot stimulate antibody formation, there will be protests from many who now use the term in a sense suitable to their particular interests. If the term is defined, "any specific poisonous substance secreted by bacteria and characterized by power to provoke the formation of antitoxin in the animal economy," we include the toxic substances secreted by the diphtheria, tetanus, and botulinus organisms, by *B. pyocyaneus*, by dysentery and gas gangrene bacilli, and possibly by a few other pathogenic organisms. We exclude, however, all other poisonous substances, among which are such bacterial products as the endotoxins which closely resemble the secreted toxins in many ways. We exclude also the closely allied poisons of non-bacterial origin, the venins and phytotoxins, both of which resemble the bacterial toxins in antigenic properties.

A broader definition which removes these objections is usually stated somewhat as follows: "Any poisonous protein substance of bacterial, animal, or vegetable origin." This definition includes all those substances commonly called toxalbumins and excludes the ptomaines and the non-protein complex poisons found in plants. Unfortunately the critical word in this definition is the word protein and this is difficult if not impossible to defend. We know too little about the chemical nature of bacterial toxins to state that they are of protein nature; indeed, not a small group of biochemists is of the opinion that they may not be protein but merely occur so closely associated with albumin in nature that we cannot isolate them by any known method. Faust⁶ thinks that the zootoxins are not only non-protein but are even non-nitrogenous and glucosidal in character. This is a far step away from our present notions of toxins. Macht and Lubin⁸ conclude from their study of menstrual toxin that the active substance is a derivative of oxycholesterol. The broader definition then must be modified before it can be accepted; it may

be strengthened by substituting "protein-like" for protein and adding a qualification specifying antigenic powers.

Neither of the above definitions makes provision for a large class of plant poisons that historically has the best claim to the term toxin and of which the members bear the class term in their names. These substances are not of protein nature and do not provoke immunity reactions. They form a heterogeneous class of substances of partly-determined composition about which we know little more than that most of them cannot be classified as alkaloids, glucosides, saponins, or in any other well-recognized category. Some few are properly classed as glucosides and do not concern us here. Many of them are resinous, some are acidic, and all are much less toxic than the bacterial toxins. In order to include them in a class with the protein-like antigens we shall be forced to designate the class "organic poisons of undetermined composition," and make subclasses of the bacterial toxins, the endotoxins, the phytotoxins, and the plant poisons. Of course such a decision would prove quite unacceptable. We cannot classify the unknown. Under such an arrangement as soon as the composition of a plant poison is understood the substance will automatically leave the class of toxins and we should have no proper control of our terminology. Our classification will be too flexible for certainty. The class character would be to a large extent destroyed and with it would go the serviceability of the system.

The last objection applies equally to extending the meaning of the word toxin to include any poison. In such a case the term would become synonymous with poison and however desirable a wealth of synonyms is for the purposes of literary elegance, neither literary nor scientific ends would be so served because of the specific meanings already attached to the word toxin. The needs of that excellent man who strives to phrase his scientific reports in language consistent with the traditions of his mother tongue will be amply supplied by the term toxic substance when he requires a synonym for the word poison.

It is evident that the problem of defining the term toxin can be solved only by the adoption of a conventional meaning that will assign to the term arbitrary limits acceptable to the majority of those interested. In attempting to suggest such a convention let us consider the related terms in use in order that our decision may be in harmony with the concepts denoted by them. The term toxalbumin

has long been used to designate those poisonous substances produced by non-bacterial cells which yet resemble the bacterial toxins in specific character such as protein-like nature, thermolability, and ability to stimulate the formation of antibodies. This term, however, postulates a protein character for these substances, and this, for reasons stated above, is objectionable. The term phytotoxin has been used to specify the toxalbumins that occur in the higher plants. It may be objected that this term should include all poisonous substances of vegetable origin, or at least those of complex composition not otherwise classified. Considered etymologically the term does govern such a wide area, but argument from origins cannot determine specific meanings in an evolving language.

Similarly the term zootoxins cannot be extended to mean any poisonous compound derived from the animal economy but is properly restricted to those toxic substances found in animal secretions or tissues that resemble the phytotoxins and the bacterial toxins in protein-like behavior and antigenic powers. The term ptomaine is now applied to substances of comparatively simple structure that are products of bacterial metabolism but not necessarily poisonous. They may readily be distinguished from the bacterial toxins by lack of antigenic character, by thermostability, and by failure to produce that disease specific to the organism from which they are derived. Many of them have been synthesized and their chemical and pharmacological relationships are well known. They are of much less importance today than they were forty years ago.

It appears manifest that the bacterial toxins, the phytotoxins and the zootoxins as they have been defined in the preceding paragraphs form a natural group of substances. The various members of this group agree in all salient characters except that of origin and even then may be considered as having a common origin in the living cell, whether animal, vegetable, or bacterial. They are always associated with proteins and have never been separated from them; they are thermolabile; highly complex in structure; and stimulate the production of antibodies. From their similarity in chemical, physical, and physiological properties we infer analogy in composition and by these properties we separate them from all other classes of poisonous substances.

For this important class of substances we have but one name, toxalbumin. We have pointed out above the serious objection to this term which makes it unavailable for our purpose. A new term

may be coined for this class or we may assign the term toxin to it. The first plan is not desirable. To define toxin by limiting it to this class serves our needs and delivers us from the difficulties attendant upon its present indiscriminate use.

In the toxin class, then, we shall include the poisonous substances secreted by bacteria as well as the endotoxins, the phytotoxins, ricin, abrin, croton, robin, and curcin, the snake venins, toxins from fish, eels, crabs, toxins from molds, yeasts, and protozoa. We shall exclude poisonous substances that do not provoke antibody formation and are not thermolabile. The enzymes must be included as toxins for they exhibit the properties of the class in addition to their catalytic activities which have hitherto overshadowed their truly toxic characters.

From these considerations we may venture to suggest that the term toxin be defined:

Any substance produced by living cells that is poisonous in small doses, is thermolabile, and stimulates the formation of antibodies when introduced into the animal body.

Summary.

The different meanings attached to the term toxin are discussed and a definition for the term is suggested to remedy the indefiniteness now apparent in the use of the word. The suggestion seems to remove objections on grounds of extension or restriction of meaning. The related terms phytotoxin, zootoxin, and ptomaine are considered and suggestions are made for restriction of their meanings. The term toxalbumin should be discarded; it is unnecessary and postulates a protein nature for the toxins that is unsupported by the modern knowledge of these substances.

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SOME PHYSICO-CHEMICAL PROPERTIES OF STARCH. I.

By Ellery H. Harvey,

Department of Chemical Engineering, Bucknell University, Lewisburg, Pa.

In spite of a rather extensive literature on starch,¹ figures for the more important physico-chemical "constants" of commercial starches are lacking. The averages of a number of determinations, all made on the same sample, have a certain significance, especially to the technical worker, and serve to indicate in a general way some of the characteristics of this increasingly important commodity.

The results given below were obtained on three different starches, all commercially available in quantity and representing good grades of what is believed to be raw starch. The methods employed are commonly known and need only be outlined.

Upon receipt, the samples were stored in airtight containers and held at a fairly uniform room temperature. Unless otherwise noted, all results were obtained on starch carrying the original moisture content.

Specific Gravity.—A vacuum-jacketed bottle pycnometer, using distilled water at 21° C., was used.

	Specific Gravity	Specific Volume
Potato starch	1.497	0.667
Corn starch	1.500	0.666
Cassava starch	1.527	0.654

Moisture.—Five-gram samples held in porcelain dishes were dried to constant weight at 105° C. in an electric oven.

Corn starch	10.6% moisture
Potato starch	11.2% "
Cassava starch	11.0% "

Ash.—Three-gram samples of original material were ashed in porcelain crucibles.

Corn starch	0.069% ash
Potato starch	0.250% "
Cassava starch	0.062% "

¹The writer has a 2500 item bibliography in manuscript, to which additions are being made.

The ash in every case reacted alkaline to litmus and gave qualitative reactions for phosphates.

Heat of Combustion.—An Emerson bomb calorimeter was used in this determination.

Corn starch	4060	calories	per	gram	of	original	starch
Potato starch	3990	"	"	"	"	"	"
Cassava starch	3941	"	"	"	"	"	"

Acidity.—Five-gram samples were shaken with 25 cc. of distilled water at frequent intervals during three hours. The supernatant liquid was filtered through paper and an aliquot titrated with dilute standard NaOH, using phenolphthalein as indicator. The acidity is reported in terms of "degrees of acidity," *i. e.*, the number of cc. of $n/1$ NaOH which would be required to neutralize 100 grams of sample.

Corn starch	1.70	"degrees of acidity"
Potato starch	1.68	" " "
Cassava starch	1.94	" " "

Size of Starch Grains.—Microscopic measurements gave the following:

	Minimum	Maximum	Average
Cassava starch	0.005 mm.	0.036 mm.	0.014-0.028 mm.
Corn starch	0.015	0.030	0.02 -0.028
Potato starch	0.045	0.100	0.055-0.065

Gelatinizing Temperature.—One gram of starch was suspended in 99 cc. of distilled water, the suspension stirred with a motor and the temperature slowly raised until the milky suspension changed to opalescence.

Cassava starch	69-70° C.
Corn starch	71-72
Potato starch	66-67

Gold Number.—The method used is that described by Bogue.²

² *The Chemistry and Technology of Glue and Gelatine*, 121-123.

While not as satisfactory as might be wished, all of the starches gave the same results, *i. e.*, about 26.

Cataphoresis.—Using a dilute starch solution and the technique described by Holmes,³ the starch was found to be electro-negative.

Specific Heat.—This was determined by tightly packing 125 grams of the sample in a small copper cylinder of very small heat capacity, sealing and holding in an electrically controlled thermostat for twenty-four hours, quickly transferring to a calorimeter and the rise in temperature noted on a Beckmann thermometer. The value for the specific heat of cassava starch, having a moisture content of 11 per cent., was 0.443. Several duplicate determinations gave the same result. The value is slightly low due to loss of heat in transfer.

Vapor Tension Above Starch Solutions.—A side-arm desiccator fitted with a thermometer was used as the containing vessel. This was connected to a mercury manometer carrying a millimeter scale.

Cassava starch solutions were prepared by suspending the proper percentage of starch in distilled water, boiling five minutes, cooling to room temperature, making up to weight and determining the vapor pressure exerted at 20° C.

Distilled water	17 mm. mercury
1% cassava starch	16 mm. "
2% cassava starch	9 mm. "
3% cassava starch	5 mm. "

Ignition Temperature.—No equipment was available for this determination. For completeness, reference is made to an important paper by Trostel and Frevert.⁴ Because of the enormous importance of dust-explosion data and the fact that the corn starch they used had a quite similar moisture content (11.1%), it may be mentioned that under the conditions they describe corn starch had an ignition temperature of 640° C. and a relative flammability of 13.7 pounds per square inch, when 51 mg. per liter of air was tested.

Dielectric Constant.—The specific inductive capacity of starch was determined by the parallel plate condenser method in which air was the dielectric, and then starch was substituted and the results referred to air as the standard.

³ *Laboratory Manual of Colloid Chemistry*, 25.

⁴ "The Lower Limits of Concentration for Explosion of Dusts in Air." *Chem. and Met. Engr.*, Jan. 28, 1924, p. 141.

Two pieces of copper foil 6 x 6 inches were mounted on heavy plate glass and separated by spacers 0.075 cm. thick. One plate was charged for stated periods and the charge allowed to leak off in a given time, air at 24° C. and 60 per cent. relative humidity being used as the dielectric. A layer of starch having a moisture content of 11 per cent. was then substituted for the air and the same procedure followed. The starch covered the plate and was pressed just hard enough to assure contact with both plates. A number of trials were made, good duplicates being obtained. Under the conditions described, starch had a specific inductive capacity of 2.8, or in other words it was about one-third as good a dielectric as air.

Refractive Index.—The following method⁵ is familiar to those acquainted with the literature of petrographic methods, but is not known to have been applied before to the measurement of the refractive index of starch grains. Further study may show the method to have considerable diagnostic value in this field.

A series of liquids in which starch is insoluble and having a regular and gradual increase of refractive indices, are prepared. A drop of one of the liquids is placed on a microscopic slide and a tiny amount of the starch is added. The whole is carefully covered to avoid air bubbles. The mount is placed under the high power of a compound microscope and focused. If the starch is of the same refractive index as the liquid, the former will be almost invisible. To get the exact point, focus sharply on a well-defined grain and raise the tube slightly with the fine adjustment. If the refractive index of the grain is higher than that of the liquid, a line of light will move in toward the grain; if the index of the liquid is the higher, the line of light will move out of the grain. In other words, the line of light always moves into the medium of higher index when the tube is raised. The reverse phenemona takes place if the tube is lowered. By trial and error, liquids are substituted with fresh mounts until no line of light moves in or out. At 20° C. the following values were obtained on the original samples:

Cassava starch	1.5331
Potato starch	1.5253
Corn starch	1.5296

⁵ Johannsen: *Manual of Petrographic Methods* (McGraw-Hill).

Rapidity of Settling.—A five per cent. suspension of cassava starch in distilled water at 22° C. was prepared. One hundred cc. of the suspension was placed in a glass tube one meter long and thirteen mm. in diameter, held in a vertical position and the lower five cc. of the tube cut off from the rest of the tube at stated intervals. The specific gravity of the liquor in the upper part of the tube gave indirectly the number of milligrams of starch settling in a given time. The table below shows that the starch settled rapidly at first and then gradually slowed down. This tendency would have been more pronounced with a starch having a greater variation in the size of the grains and would have been more strikingly evident in the case of cassava had the work been continued a longer period of time.

Time	Settled
1 minute	0.0175 grams
2 minutes	0.0182 "
3 "	0.0202 "
4 "	0.0244 "
5 "	0.0260 "
6 "	0.0288 "
7 "	0.0320 "
8 "	0.0380 "
9 "	0.0400 "
10 "	0.0440 "
15 "	0.0640 "
20 "	0.0880 "
25 "	0.1093 "
30 "	0.1320 "

Polariscopic Determination of Starch.—While the quantitative determination of starch when alone is not often required and does not present particular difficulties when determined by the usual gravimetric methods, it was felt several of the more convenient optical methods should be scrutinized and the results compared.

Crispo's method:⁶ 3.391 grams of starch are made into a paste with water, washed into a 200 cc. flask, 50 cc. of 6 per cent. KOH solution added with agitation, water added until the flask is three-fourths full, the latter being placed on a boiling water bath for one hour, with frequent shaking. After cooling, the flask is filled to the

⁶ *Ann. chim. anal. appl.* 4, 289-290.

mark, the liquid filtered until clear and polarized in a 200 mm. tube. The polariscopic reading in degrees Ventzke, multiplied by 6, indicates the percentage of anhydrous starch.

While all of the methods gave low results, this one was the least offender:

	Actual Starch	% Starch by Crispo's Method
Cassava	88.87%	86.4
Potato	88.55	84.0
Corn	89.33	81.6

Ewer's method:⁷ 25 cc. of glacial acetic acid is run into a 200 cc. flask, 5 grams of starch added, the flask closed and well shaken. The stopper and neck of flask are washed down with 20 cc. of additional glacial acetic acid and placed on a boiling water bath for 10 minutes; 10 cc. of 10 per cent. HCl is then added and the flask left on the boiling water bath exactly 10 minutes, shaking thoroughly every minute. Hot water is then added to make a total of about 180 cc. and the solution heated on the boiling water bath for 15 minutes. Cool, clarify by adding a few cc. of dilute potassium ferrocyanide or zinc sulphate solution; make up to the mark, filter and polarize in a 200 mm. tube. Calculations are made on the basis of a 5 per cent. solution, 200 mm. tube:

	Actual Starch	% as Given by Ewer's Method
Cassava	88.87%	83.8
Potato	88.55	80.9
Corn	89.33	82.2

Lintner's method:⁸ To 2.5 grams of sample add 10 cc. of water. Mix and add 15-20 cc. of HCl (sp. gr. 1.19) and stir to a homogeneous paste. Allow to stand undisturbed for 30 minutes. Transfer to a 100 cc. flask, using HCl (sp. gr. 1.125). Add 5 cc. of 4 per cent. phosphotungstic acid solution, bring to mark and filter. The polarization is made in a 200 mm. tube with a sodium light. Since the specific rotation of starch saccharified under these conditions is

⁷ *Zeit. offentl. Chem.*, 1905, 11, 407-415.

⁸ *Villavecchia*, Vol. 2, 64.

(a)d = 202°, the percentage of starch, a, in the sample is given by
 $a = 9.9 P$, P being the rotation observed.

	Actual Starch	% Starch Given by Lintner's Method
Cassava	88.87%	76.74
Potato	88.55	74.20
Corn	89.33	74.90

A considerable number of duplicates were run without affecting the results given. It seems evident that without modification the methods tried are not capable of giving correct results.

(*Part II will appear in a subsequent number.*)

DIETHYLPHTHALATE IN TINCTURE OF IODINE.

Jos. W. E. Harrison, P. D., Ph. M.

Recently, in examining a sample of tincture of iodine, it was noticed that upon dilution with water it became cloudy much in the same manner as the formerly official potassium iodide free tincture. The iodine content of the tincture met the present standard but upon evaporating to determine the iodide content a black residue was obtained.

The residue, which should have consisted of potassium iodide, was only partly soluble in water, the insoluble portion being carbon. When evaporating it was noticed that white fumes were being given off over the violet vapor of iodine, this leading to the thought of some denaturant being present, and immediately diethylphthalate seemed to be the most likely one.

A portion of the sample was decolorized with sodium thiosulphate and then one mil of sodium hydroxide solution added and the solution transferred to a separatory funnel. It was then shaken out with petroleum ether several times and the ether evaporated at a gentle temperature. An oily residue was obtained which was weighed, it being 1.85 per cent. by weight in the original sample. Confirmatory tests for the ester established its identity as diethylphthalate.

A modification of the official method for the estimation and examination of the potassium iodide was necessary, so the following

technique was followed: Evaporate and gently heat the residue from twenty mls in a porcelain capsule, break up with a rod and digest with twenty-five mls of hot water. Filter and wash with hot water until free from iodide and evaporate the filtrate in a tared glass capsule. Weigh and calculate the percentage of iodide and examine according to the U. S. P.

It was found that small quantities of the ester could be detected by shaking out in the above manner and tasting the resulting residue, diethylphthalate having a most distinct and peculiar taste.

LaWall Laboratories, Philadelphia, Pa.

**ABSTRACTS OF PAPERS READ AT THE SCIENTIFIC
SECTIONS OF THE AMERICAN PHARMACEUTICAL
ASSOCIATION (1924 MEETING).**

A PALATABLE COD LIVER OIL CONCENTRATE POSSESSING THE CURATIVE PROPERTIES OF COD LIVER OIL. By Harry E. Dubin.

Cod liver oil has been used in medicine for many years but until recently its use was on a purely empirical basis. With the indisputable proof at hand that cod liver oil is really a specific for the treatment of rickets, renewed interest has been aroused in the possibility of isolating the active principle responsible for its therapeutic action.

Considerable research has been done in this direction and some progress has been reported by various investigators. In our laboratory, we have been engaged in this work since January, 1922. Although we have been unable to actually identify the active principle of the oil, we have nevertheless succeeded in preparing a highly concentrated product free from oil, practically odorless and tasteless and equal in therapeutic value to fresh cod liver oil.

Thus from 1000 gm. oil, it is possible to obtain 0.1 gm. of concentrate which, if mixed with 1000 gm. sugar, is just as potent as the fresh cod liver oil, gram for gram.

As originally obtained, the cod liver oil concentrate is a brown semi-crystalline pasty mass. In combination with sugar it appears as a creamy white powder which may then be compressed into tablets of any desired size and dosage.

Almost 700 animal experiments have been carried out to prove the worth of this cod liver oil concentrate. Clinical experiments have also been made, showing clearly by means of X-Ray and otherwise that the concentrate is as effective in children as in animals.

A PHARMACODYNAMIC STUDY OF THE ANTHELMINTIC PROPERTIES OF TWO OILS OF CHENOPODIUM. By A. Richard Bliss, Jr., A. M., Ph. D., M. D.

The inadequate supply of oil of chenopodium for human and for animal medication prompted these pharmacodynamic investigations. (Konantz: *J. A. Ph. A.*, XIII, 3, Mar. '24.) No pharmacodynamic investigations of the "Western Oil" had been made up to the present study.

Samples of oils prepared by Konantz were used in the investigations. These oils Konantz showed met the U. S. P. IX specifications. (Konantz: *J. A. Ph. A.*, XIII, 3, March, '24.) One of the oils was distilled from plants cultivated by Konantz in Adams County, Illinois; a second was distilled from cultivated wild wormseed plants found in the same locality; the third oil used was distilled from plants which had been shipped from Carroll County, Maryland. The last oil mentioned was used for comparison.

The common ascarid of the dog was used as the test worm in determining the anthelmintic values of the three oils studied. The method employed was that of Hall and Foster (*J. A. M. A.*, LXVIII, 1917), *i. e.*, the collection of all worms from the feces after the treatment and from the dog post-mortem. One fluid ounce of castor oil, which is protective against marked gastro-intestinal irritation by oil of chenopodium, was given immediately following the dose of the volatile oil.

The twenty-four dogs which were treated with western oil of chenopodium showed a total of 267 ascarids; an average of 11-plus per dog. The treatment removed 263 of the worms and was therefore 88.50 per cent. effective against ascarids.

The eighteen dogs which received the treatment with the wild western oil of chenopodium showed a total of 161 ascarids; an average of 9 per dog. This treatment removed 155 worms, and was accordingly 96.27 per cent. effective against ascarids.

Twenty (20) dogs treated with the Maryland oil of chenopodium showed a total of 196 ascarids; an average of 9.6 per animal.

The Maryland oil treatment removed 188 of the parasites and was consequently 97.91 per cent. effective against ascarids. Examination of the digestive tracts of the sixty-two animals used in this study showed that but nine (three in each of the three series, *i. e.*, three dogs for each oil), had a slight degree of inflammation. Practically all of the nine dogs so affected were large dogs which had received the larger doses of the oils of chenopodium.

The writer's conclusions are: (1) Oil of chenopodium properly distilled from plants cultivated in the Middle West is as efficacious against ascarids in dogs as the "Maryland Oil." (2) On the basis of the experiments with dogs, the writer ventures to state that these findings apply also to man.

THE PERMANENCE OF TINCTURE OF IODINE, U. S. P. By D. M. Copley.

A research was undertaken to determine the stability of Tr. Iodine, U. S. P. under various conditions of storage and use. Several liters of the tincture were made and packaged in glass as follows: amber bottles, filled and half-filled, and stoppered with cork, rubber and ground glass stoppers; also flint bottles under the same conditions. These samples were then stored, some in the light and some in the dark, some at room temperature and some in the refrigerator. Each of the samples were assayed very carefully at the end of three and six months. It was found that either flint or amber glass was satisfactory and that cork and rubber stoppers were satisfactory, there being no change in the assay of the contents of such bottles. Glass stoppers were not so satisfactory as the tincture often crept between the stopper and the neck of the bottle forcing the stopper up a little and leaving a coating of potassium iodide. This allowed the alcohol to slowly evaporate with a consequent increase in the iodine content of the tincture.

Other samples were subjected to conditions approaching those of actual use, such as the bottles being opened for a short time daily, or even left open continuously. These were assayed weekly. In these cases a slow increase in iodine content was found in the bottles opened daily, while the tincture left open all of the time increased in iodine content until in a few weeks it was well outside of the U. S. P. limits.

DIETHYLPHTHALATE III. By J. A. Handy and L. F. Hoyt.

Further critical study has been made of the detection tests for diethylphthalate, including the new test by Eilles which recently appeared in the literature. The effects of (1) substituting other hydroxybenzene for the pyrogallol used in the Eilles test and for the resorcinol used in the fluorescein test; and (2) of interfering acids, aldehydes and ketones in the detection tests for diethylphthalate have been observed and tabulated. The Eilles test while rapid, has been found to be less sensitive, and more subject to error in interpretation of results, than the fluorescein test.

THE USE OF THE POTENTIOMETER IN THE QUANTITATIVE ANALYSIS OF ALKALOIDAL SOLUTIONS. By John C. Krantz, Jr.

It is the purpose of this paper to point out how the potentiometer may be used to estimate the hydrogen ion concentration of alkaloidal solutions, and this in turn being expressed in cc. of an acid of definite normality, may be used as a means to calculate the alkaloidal concentration of the solution.

NOTE ON SEPARATION OF GLYCERIN FOR QUALITATIVE IDENTIFICATION. By Charles A. Herrmann.

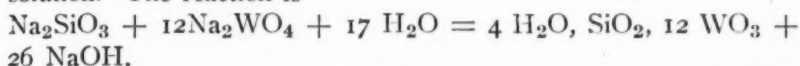
The presence of sugars, colors and other organic matter interferes with the delicate color reactions in applying Denige's test for glycerin. The purification by means of solvents is time consuming and not always effective. Simple distillation does not carry over sufficient glycerin to give qualitative test. Purification may be effected by adding one-half volume of concentrated sulphuric acid and distilling.

SILICO-TUNGSTIC ACID AS A QUANTITATIVE REAGENT FOR ALKALOIDS. By George D. Beal and Edward O. North.

This paper deals with the preparation of silicoduodecitungstic acid, its properties and its use as an alkaloidal reagent. This acid was first prepared by Marignac in 1863. Goddefroy in 1879 and

Bertrand, professing ignorance of Goddefroy's work, in 1899, called attention to the fact that this acid formed very insoluble salts with some alkaloids. Javillier continued the work on alkaloids, and in 1911 Chapin published a direct method for the gravimetric determination of nicotine in tobacco preparations.

The authors have prepared this acid by a modification of a method proposed by Copaux, mixing together concentrated solutions of sodium tungstate and sodium silicate (water glass) and heating the mixture at the boiling point, adding all the while concentrated hydrochloric acid at the proper rate to maintain a practically neutral solution. The reaction is



Finally a large excess of hydrochloric acid is added and the silicotungstic acid extracted as an ether complex by shaking with ether. The bulk of the ether may be allowed to evaporate spontaneously, and the drying completed in an air-oven at 70 degrees to 75 degrees. The product so prepared has a practically colorless crystalline solid, non hygroscopic and very stable. The potassium and ammonium salts have also been prepared and analyzed. The formula of the former is $4\text{K}_2\text{O}, \text{SiO}_2, 12 \text{WO}_3, 14 \text{aq}$, and of the latter $4 (\text{NH}_4)_2\text{O}, \text{SiO}_2, 12 \text{WO}_3, 1 \text{aq}$.

Apparently the stable alkaloidal salts result from the replacement of but four of the acid hydrogens. Not only the common alkaloids but other tertiary bases form more or less insoluble salts with this acid. Salts of nicotine, quinine, cinchonine, morphine, codeine, apomorphine, narceine, narcotine, strychnine, brucine, pyridin, cocaine, caffeine, theobromine, veratrine, colchicine, quinolin, atropine, hyoscyamine, berberine and hydrastine.

Volumetric Determination of Alkaloids. Solutions of malachite green in six normal hydrochloric acid have a color varying from orange red to brownish yellow depending upon the concentration. A drop of an aqueous solution of silicotungstic acid will restore the greenish blue color to this solution, as will the addition of a larger excess of water. The endpoint is sharp however for the reagent. When an alkaloid forming an insoluble silicotungstate is dissolved in 0.6 normal hydrochloric acid and titrated with a 0.01 molar solution of silicotungstic acid, the malachite green serves as a very sensitive outside indicator for an excess of the reagent. The silicotungs-

tic acid solution may be standardized against a solution of pure cinchonine as above or acidimetrically with standard sodium hydroxide, using methyl orange as the indicator.

Using the proposed Scoville method for the assay of cinchona, the chloroform residue was weighed as in the U. S. P. method. This residue was then dissolved in standard acid and the excess titrated with standard alkali, using methyl red. The solution was then made approximately normal with hydrochloric acid and titrated with silicotungstic acid, using the malachite green indicator. The same factor was used for the alkaloidal mixture in both the alkalimetric and silicotungstic acid titrations. A most excellent agreement in results was obtained in all three methods. It was also found possible to omit the purification of the alkaloid by extraction from alkaline solution with chloroform. The sulphuric acid extract from the original ether-chloroform extraction was titrated directly with silicotungstic acid, obtaining results which agree satisfactorily with those obtained by the longer methods.

Nux vomica, belladonna leaves, stramonium leaves, hydrastis and tobacco extracts have been assayed volumetrically by procedures similar to the above, obtaining results which check satisfactorily those obtained by the standard procedures. Morphine silicotungstate is apparently too soluble to serve as the basis of a morphimetric assay.

1. NOTES ON PEPSIN PREPARATIONS. By C. C. Glover.

This concludes a series of tests on U. S. P. and N. F. pepsin solutions extending over a period of four years and includes the results obtained with the use of preservatives.

II. THE COMPOSITION OF BISMUTH SALT IN GLYCERITE OF BISMUTH. By C. C. Glover and T. F. Thorsberg.

A review of literature on all bismuth tartrate solutions followed by methods employed, in assay, the results of which indicate that the salt is not a normal tartrate but a mixture of basic tartrates.

ON THE STANDARDIZATION OF BLOOD COAGULANTS. By Alfred T. Perkins and Wily M. Billing.

Blood coagulants as found on the market consist of three general types, *i. e.*, those containing thrombin, kephalin or tissue fibrinogen.

The common methods of testing the activity of coagulant consists in adding an oxalate or a citrate to the blood and later adding a calcium salt or blood serum.

It has been found that by taking the blood directly from an animal's heart (or veins) that these two steps can be avoided and that good checks as to the activity of the coagulant can be obtained on one or several animals, provided the animals have been starved for a period of twenty-four hours.

MODIFICATION OF COW'S MILK FOR INFANT FEEDING. By Elizabeth Gates and Wyly M. Billing.

The theoretical considerations of various methods of milk modification, especially those as presented by Terry in her paper to the *Jour. A. Ph. A.*, have been studied from the laboratory standpoint with the idea of grouping together those factors which will lend themselves to the ideal type of milk modification. Such preparations have been made and their effect upon the curdling and digestion of cow's milk by rennin and pepsin have been studied.

A STUDY OF THE STABILITY OF FLUID EXTRACTS. By Wyly M. Billing and Alfred T. Perkins.

Representatives of three types of fluid extracts which are commonly standardized by three totally different methods, *viz.*, chemically, physiologically and organoleptically were chosen for study. They were respectively cinchona, ergot and sarsaparilla. All of these are known to throw out a considerable precipitate over a period of time.

The method employed was to alter the hydrogen ion concentration to the point of minimum stability, thus obtaining a maximum precipitate of the inactive constituents in a short while.

Assays made before and after show that the Ph chosen was such that the active principle was not destroyed but remained completely in solution. Samples treated by this process have been found to retain their clarity much longer than the original products.

A CHEMICAL EXAMINATION OF THE ROOT OF *LEPTOTÆMIA* DISSECTA. By Nellie Wakeman.

One hundred pounds of the ground root of *Leptotæmia dissecta* yielded 274 grams of volatile oil, a little less than 0.6 per cent., and a large quantity of alcoholic extract.

The volatile oil contains 18-20 per cent. of an ester, calculated as methyl valerianate, and 49-50 per cent. of total alcohols, calculated as menthol. The acid present is valeric acid, but the alcohol has not been identified. At one stage in the fractionation of the saponified oil a solid white substance, resembling borneol, separated in the condenser. Borneol, however, was not identified in the fraction.

The alcohol was evaporated from the alcoholic extract which then separated into two layers, a thick dark oily portion and an aqueous portion. Both were strongly acid in reaction.

The oily layer was distilled with steam. A small quantity of volatile oil and a large volume of aqueous distillate were obtained. The volatile oil resembled that previously obtained. The aqueous distillate contained valeric acid, methyl alcohol, ethyl alcohol. (Ethyl alcohol had been used in preparing the extract), and methylamine.

The nonvolatile portion of the oily layer contains a considerable quantity of esters and free acid which have not been investigated.

THE ELIMINATION OF MERCURIALS WITH PARTICULAR REFERENCE TO MERCUROSAL. By L. W. Rowe.

Suitable doses (as large as possible) of four mercury compounds; namely, mercuric chloride, mercury salicylate, mercury succinimide and mercurosal were injected intravenously into dogs over a period of two weeks. The urine and feces excreted by these animals were collected for each twenty-four hour period and submitted to chemical assay for mercury content. The results of the chemical assays are reported, also the condition of the various animals following the intensive treatment. Percentages of the total mercury that were eliminated by the kidneys and intestines over the three weeks period are enumerated.

FURTHER STUDIES ON INSULIN AND THE SKIN. By E. F. Müller and H. B. Corbitt.

In a previous paper the authors have presented the results of studies on intradermal and subcutaneous injections of insulin in different rabbits and have concluded the intradermal method is more efficacious.

Recognizing the great variation in animals, further tests have been made using the same animals with three different methods of administration, intradermal, subcutaneous and intravenous.

The factor of emotional hyperglycemia has also been studied and tests made to determine its importance and effect on the experiments.

The results of previous tests are confirmed. The evidence seems to show that insulin does not act alone by way of the body fluids, as do non-specific fluids, but may also act by way of the involuntary nervous system indicating that the skin plays an important part in the effectiveness of specific as well as non-specific agents.

The order of efficacy of the three methods of administration as determined by our experiments is intradermal; subcutaneous; intravenous.

OIL OF ECHINACEA ANGUSTIFOLIA. By Fritz Bischoff and Edward Kremers.

This oil, isolated by John Uri Lloyd, has been submitted to a preliminary investigation which has resulted in the discovery of a tetrahydro sesquiterpene, $C_{15}H_{28}$, reducible to an isopentadecane, $C_{15}H_{32}$.

MEDICAL AND PHARMACEUTICAL NOTES

A NEW TEST FOR BILE PIGMENTS.—A new test for the detection of bile pigments in urine, bile and serum has been devised by R. Kapsinow (*Jour. Amer. Med. Assoc.*, 1924, Mar. 1, 687). The test makes use of the color change produced by the conversion of bilirubin to biliverdin by means of the Obermayer reagent. It is immediate in its response and more delicate than the Gmelin and Rosenbach reactions.

The Obermayer reagent is prepared by dissolving 0.3 gm. of ferric chloride in 100 cc. of concentrated hydrochloric acid, sp. gr. 1.19. This reagent is ordinarily used for the detection of indican in urine. Equal quantities of the urine and the reagent are mixed, 2 or 3 cc. of chloroform added, and the whole well shaken. A positive test is indicated by the chloroform taking the blue color of the indigo.

In testing for bile pigment the chloroform is omitted; 0.5 cc. of the reagent is added to 5 cc. of urine, and if bile pigment is present the color at once appears as deep green. If only traces of pigment are present the color will appear after the test tube has stood for a few minutes in warm water. Bile may be tested in the same way. For the testing of serum, 4 cc. of 95 per cent. alcohol is added to 2 cc. of serum to precipitate the proteins, and the mixture is centrifugalized. The clear supernatant liquid is withdrawn and 0.5 cc. of Obermayer reagent is added. The green color will appear in a few seconds.

PSICAINE.—Psicaine¹ is the tartrate of dextro-pseudo-cocaine, a synthetic isomer of the alkaloid. As described by Willstätter² it has the same formula as cocaine tartrate, $C_{17}H_{21}O_4N \cdot C_4H_6O_6$; it is dextro-rotatory, natural cocaine being laevo-rotatory. Psicaine is a microcrystalline powder, soluble in water 1:4, less soluble

¹ The word is spelt "Psikain" in German literature: we have altered the spelling in accordance with the rules of scientific English.

² Willstätter, R.: "Ueber die Synthese des Psikains." *Münch. med. Woch.*, 1924, June 27, pages 849-50.

in alcohol. The aqueous solution is acid to litmus, has a bitter taste, and causes a persistent numbness on the tongue. Its solution can be sterilized by heat without decomposition and is not affected by the addition of adrenalin.

The dextro-rotatory character of psicaine affects its pharmacological action. It is more soluble in lipoids and consequently is nearly twice as active as the natural alkaloid, while its toxicity is about half when injected subcutaneously, though by the intravenous route its toxicity is about the same as that of cocaine. Its anesthetic action is exactly that of cocaine in quality, but more powerful, that is to say, less will produce the same effect.

While psicaine has the same pharmacological effect as cocaine, it has not yet been determined whether it possesses the initial psychic effects to render it liable to the same misuse. Gottlieb says that only time and experience will show whether this may be feared. If its quicker absorption from mucous membranes prevents such effects as those of cocaine, it is possible that psicaine may be available as a remedy for the cocaine habit.—*The Prescriber*.

BIARIUM SULPHATE FOR RÖENTGEN WORK.—The advantages of barium sulphate as a contrast material in x-ray work over the bismuth compounds formerly used, have been so evident that the latter have been practically abandoned. An unexpected danger, however, developed on account of the frequent use of barium sulphide as a depilatory, which led to substitution of this with fatal results. Dr. Bohrisch, of Dresden, communicates to the *Pharmazent. Zentralh.* (1924, 65, 429) the results of investigation into some commercial forms of the sulphate, and especially recommends that all prescription for it should be supplemented by the words "for x-ray purposes." This precaution is, indeed, rather more necessary in German practice than in English, as the names for barium sulphate and barium sulphide in German are, respectively, "Baryum sulfuricum" and "Baryum sulfuratum."

Leading manufacturing firms are now offering barium sulphate of high quality, especially carefully freed from soluble barium salts, all of which are more or less poisonous. The physical condition

of the material is important. Smoothness and fineness of the powder is advisable, as a coarse, slightly granular powder does not form as convenient a mass with water. Bohrisch found one sample to give a very distinct opalescence with silver nitrate in acid solution, and found that this was due to sodium chloride. He regarded the sample as safe, but it may be questioned whether any impurity that is capable, theoretically, of reacting to form a soluble barium salt should be allowed. It would seem that a salt so insoluble as barium sulphate can be prepared easily of a high degree of purity, although it is known that in precipitating, it carries down by adhesion more or less of the other salts present. Still, these can be removed by subsequent treatment.

H. L.

UNUSUAL INGREDIENTS IN URINE.—L. Baechler reports in *Schweiz. Apct. Zeit.* (1924, 62, 489) two instances in which unusual substances were found in urine samples, giving rise to misleading reactions. In one case, a test was applied for indican, but instead of the indigo-blue tint, a reddish-violet was obtained. Further investigation showed that the color reaction was due to iodine, and the condition was supposed to be iodine poisoning, but this was not verified.

In a second sample, in which tests for acetone, sugar and acetoacetic acid were made, the last named was not found, but the reaction for acetone with sodium nitroprusside was marked. All tests for sugar were, however, negative. The acetone test was repeated, and it seemed that the ring was redder than was to be expected. Other tests were used, and in the course of the manipulations it was discovered that the sample would give a distinct red tint with ammonia alone. The presence of some substance derived from a medicament was suspected, and santolin, phenolphthalein and anthroquinone were suggested. Experiment showed that phenolphthalein was present. It was learned that the patient had been taking a purgative preparation, but its composition could not be ascertained. It was probably one of the now widely-used phenolphthalein mixtures.

H. L.

THE COMPOSITION AND ANALYSIS OF DOUBLE-STRENGTH TINCTURE OF GINGER.—Messrs. Eden, Marsh and Lythgoe, of the Massachusetts Department of Public Health, communicated to the sixty-fifth meeting of the American Chemical Society (New Haven, April, 1923) a paper on this subject which has appeared in *JIEC*, 1924 16, 816. The sale of alcoholic extracts of ginger under various titles has been quite extensive, obviously as surreptitious methods of getting alcoholic beverages. For some years, the market was met by the manufacture of preparations with low alcoholic content containing but little of the ginger resins, but marked ginger odor and flavor. Such dilute extracts, if not properly labelled, constitute a violation of the food and drug law, and data in regard to their composition have been published by Street, Lythgoe and Nurenberg and Harrison and Sullivan.

At the present time, Eden, Marsh and Lythgoe find that tinctures of ginger with low alcoholic content have practically disappeared from the market. The Bureau of Internal Revenue, in an effort to prevent the use of ginger tinctures for beverage purposes, issued an order in November, 1920, classifying the U. S. P. IX preparation as fit for beverage purposes, and therefore salable only in the manner prescribed for other preparations of the type, whether sold as Jamaica ginger, essence of ginger, extract of ginger, or by other names. A tincture of ginger double the strength of the official preparation was designated as "unfit for use for beverage purposes," and the question of the composition of such a solution arose and also the proper method of analysis. It was to these problems that Eden, Marsh and Lythgoe directed their attention and their paper gives the results of extended work, which results have been entirely satisfactory as a basis for legal proceedings concerning the sale of ginger tinctures. The approved methods of analysis are as follows:

Total Solids.—Place a flat-bottomed platinum milk dish on a tray upon the top of a steam bath, measure 10 cc. of the tincture into the dish; when the contents appear to be dry, place the dish over the live steam and dry for 10 hours. Cool in a desiccator and weigh. Express results as grams per 100 cc.

Alcohol.—Determine the specific gravity and compute the alcohol by means of a standard alcohol table. Hehner's table was used

in this work. The specific gravity of ginger oleoresin is so near that of water that the error in the alcohol percentage is not more than 0.20 with the samples made.

Unless great care is taken, erroneous results will be obtained in determining the total solids of double strength tinctures of ginger, the figures being too high.

Commercial double-strength tincture of ginger should be expected to have total solids between 1.4 and 2.0 grams per 100 cc.; if less than 1.4 the sample is open to suspicion, if less than 1.3 the sample is not double strength, if about 2.0 the solids may have been reinforced by substances other than ginger.

If the total solids of commercial samples fall between the limits set for pure, double-strength tincture of ginger, it is advisable to determine the alcohol-soluble or other soluble solids in order that the purity of the article may be more nearly established.

H. L.

THE HYDROLYSIS OF METAPHOSPHORIC ACID.—It is well known that a solution of metaphosphoric acid in water slowly passes into the ortho-form. The completion of the process can be determined by the fact that only the meta-form coagulates albumin. Many investigations have been made to determine the course of the change. It is known that free mineral acids, as might be expected, accelerate it. Leopold Pessel, of the chemical laboratory of the University of Vienna, has reviewed the literature and also made a careful investigation into the changes and the conditions favoring them. His results appear in *Monatsh. f. Chemie.*, 1922, 43, 553. He finds that the change from meta- to ortho-form is not accompanied by an intermediate production of the pyro-form.

H. L.

NOTES ON SOME REACTIONS OF DIETHYLPHTHALATE.—In the course of experiments for comparing some of the suggested tests for this ester, the main results of which appeared in a recent issue of THE AMERICAN JOURNAL OF PHARMACY (1924, 96, 503), its reactions with some other phenolic compounds than phenol and resorcinol were studied. When heating with sulphuric acid at a

high temperature is used, striking reactions are produced in many cases, but the results are not constant. Andrew has pointed out that these high temperatures are liable to give untrustworthy results. It seemed worth while, therefore, to determine if trustworthy results could be obtained by applying the essential principle of Andrew's method, namely, operation at a temperature about that of boiling water.

So far as concerns the phenolic bodies available as photographic developers (pyrocatechol, hydroquinone and pyrogallol) no use can be made, for the residue obtained in the evaporation of the sample with sodium hydroxide is alkaline, unless the proportion of the ester is very large, and as soon as solutions of these substances come in contact with such residue they oxidize and produce deeply colored solutions. With phenol, orcinol and beta-naphthol, but little interfering color change occurs, but even notable proportions of the phthalate do not give characteristic reactions. It is an interesting example of the effect of position of the substituting radicles, that while the 1-2 and 1-4 dihydroxybenzenes are promptly changed in alkaline solution, the 1-3 form behaves very differently. It was thought possible that the delicacy of the resorcinol method might be increased by examining the liquid by ultra-violet radiation in a dark room, but a solution containing 1 drop of the ester in 1000 cc. of liquid did not give any appreciable fluorescence when 10 cc. were taken for the test. A larger quantity may give the result. This point will be examined.

H. L.

SOLID EXTRACTS

Cancer has been legally established as one of the industrial hazards in cotton spinning, by a recent decision in a British court.

Animal experimentation has shown that cancer may be induced in white mice by painting the skin with those ingredients of soot that can be dissolved in fat. A cotton spinner contracted cancer in a part of his body constantly kept in contact with his machine, and his heirs won a suit against his employer, claiming that the disease was induced by the dirty oil rubbed into his skin. Since the spinner ceased to be connected with the cotton industry eight years before his death, the insurance companies and cotton manufacturers are greatly concerned over such a precedent. Unless the court's decision is overruled on appeal, there will probably have to be readjustments made in industrial insurance in England, as well as in the administration of the Workmen's Compensation Act.

Levulose, a valuable sugar heretofore so difficult to produce that it has cost from \$30 to \$110 a pound, can now be made cheaply enough to be used on anybody's table, by a process worked out in the laboratories of the U. S. Bureau of Standards. It is extracted from dahlias and from Jerusalem artichoke, the latter an exceedingly common weed of the wild sunflower family that grows abundantly in low, moist places, too wet for profitable crop cultivation.

Levulose is chemically closely related to glucose, which is the sugar

forming the base of most table syrups now used. The bureau has formerly been able to produce a levulose syrup, but has now succeeded also in extracting a pure crystalline sugar suitable for table use.

A chemical product which resembles glass and can be used for many of the same purposes, has been produced in Germany. It can be rolled, bored, polished or cut and does not have the tendency of glass to splinter. Because of this quality it has been recommended for the glass panes of automobiles, optical instruments, ornaments, and toilet articles.

Fritz Pollak, the inventor, arrived at this product by condensing carbamide and theocarbamide with formaldehyde. Amides are simple, nitrogenous substances related to proteins.

Sir Ernest Rutherford, at the Franklin Institute Centenary, in his able lecture on the Inner Structure of the Atom, referred to the peculiar similarity between the atomic system and the solar system.

Centuries ago the blundering alchemist saw the same light perhaps when lead he devoted to Saturn and iron he named after Mars—gold was the sun of his system and silver his queen of the night.

In a normal man at rest each cavity of the heart expels about four litres per minute. During violent exercise, when the requirements of the body for oxygen may be increased

tenfold, this quantity rises to twenty-four or even to over thirty litres (three gallons) per minute. These figures convey only imperfectly the enormous rush of blood which is being effected by the heart under these conditions. An ordinary house spigot will deliver nothing like thirty litres per minute; to obtain this amount it is necessary to have recourse to a large tap such as that which is supplied to a bath. It means that during active exercise the whole blood must pass through the heart and round the body every ten seconds, and complete the circulation of the body six times in every minute.

Insulin, the recently discovered remedy for diabetes, first held to be produced exclusively in the pancreas, has now been found to exist in many other parts of the body. Two of the original discoverers now have evidence of its presence in considerable concentration in the thymus and thyroid glands, which lie in the throat; in the submaxillary gland, under the jaw; and in liver, spleen and muscle tissue.

A needle can be magnetized by stroking it with a magnet. In the same sense food lacking in vitamins may be charged with these accessory substances by mere exposure to sunlight. Thus foods given a sunbath are as effective in preventing and curing rickets as foods rich in anti-rachitic vitamin A. Dr. Harry Steenbock, professor of agricultural chemistry at the University of Wisconsin here has discovered.

As a result of experiments he has found that merely placing food in the sunlight will endow it with growth-promoting properties supposed to be possessed only by foods rich in vitamins, in spite of the fact that "irradiated" or "illuminated" foods may contain no vitamins before exposure to the light.

"Hundreds of rats have been used for these experiments," Dr. Steenbock explained. "Rickets was produced in these animals by first feeding rations known to produce this disease. Then they were cured by feeding them with exactly the same ration which had been exposed to sunlight."

FREE PUBLIC LECTURE COURSE.**1924—1925.**

**Philadelphia College of Pharmacy and Science,
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The lectures will begin at 8.15 P. M.

This is the fourth season of the effort of the Philadelphia College of Pharmacy and Science to contribute to the educational welfare of the community at large by means of a series of popular scientific subjects.

The lectures are delivered by members of the Faculty of the institution and are abundantly illustrated by experiments, lantern slides and specimens.

Those which have been presented during the past three seasons have been attended and enjoyed by many interested persons.

They are given in a form which is simple and understandable and which is of interest alike to the person who has been technically trained along particular lines and to the one who is simply interested in scientific subjects in general.

These lectures are subsequently published in book form. Two volumes are now available and may be secured for one dollar each from the office of THE AMERICAN JOURNAL OF PHARMACY.

First Lecture**Thursday Evening, October 9, 1924.****ARCTIC AND TROPICAL PENNSYLVANIA.**

By Henry Leffmann, A. M., M. D.

**Lecturer on Research, Philadelphia College of Pharmacy and Science;
Hon. Professor of Chemistry, Wagner Free Institute of Science, etc.**

The testimony of the rocks is that the region in which Pennsylvania is included has undergone extreme variations of climate. At one time warm, moist conditions produced tropical plants such as tree ferns, in abundance. From these much of the coal now be-

ing mined was produced. At another time an ice sheet nearly half a mile deep covered a portion of the area, and the torrential waters from the melting of this modified the land. The "terminal moraine," characteristic of glaciers, can be traced in many parts of the State. Volcanic actions of great severity have also occurred and left distinct traces. Lantern slides illustrating these conditions will be shown.

Second Lecture

Thursday Evening, October 23, 1924.

BRIDGE CONSTRUCTION.

By George Rosengarten, Ph. D.

Instructor in Physics, Philadelphia College of Pharmacy and Science.

The bridge is an important object of interest to the community. Different types of Bridge Truss will be considered with a study of the stresses and strains to be resisted. The use of the 10,000,000-pound testing machine. The cantilever and suspension bridges as types suitable for long spans—the concrete arch. A review of the important bridges in Philadelphia past, present and future. The new Delaware River Bridge will be considered in detail.

Third Lecture

Thursday Evening, November 6, 1924.

CHEMISTRY IN AND ABOUT THE HOME.

By Freeman P. Stroup, Ph. M.

Professor of Chemistry, Philadelphia College of Pharmacy and Science.

Someone has said that an insurance agent with a knowledge of chemistry is better equipped for his job than is the one who is ignorant of the subject. Surely, then, a cook, who is daily dealing with chemicals (all materials are chemical in nature) and chemical processes (most cooking and baking processes involve chemical reactions), ought to be better equipped if possessed of a working knowledge of the materials which are handled, and the changes

which they undergo under the influence of heat. The lecturer will endeavor to give in easily understood language some of the principles underlying many household operations, particularly kitchen operations, with the hope that his feminine hearers may become even more adept practitioners of the culinary art than they are now, and that his masculine hearers, having been given a clearer insight into the difficulties that confront the kitchen chemist, will be a little more charitable in their judgment of the products of the household "laboratory."

Fourth Lecture**Thursday Evening, November 20, 1924.****CHEMISTRY AND COLOR.****By J. W. Sturmer, Ph. M., Phar. D.****Dean of Science, Philadelphia College of Pharmacy and Science.**

Color is a mystery. To be sure, we know something about the rainbow, and more recently science has revealed much concerning the color-effects exhibited by films of oil, wings of insects, and the feathers of birds. We know about pigments, dyes and the coloring matters in flowers. And now science is searching for the real answer to the question, Why is a red substance red, or a blue one blue?

Paints and Pigments provide fascinating topics for study from several standpoints.

The lecture will deal with certain advances in the study of colors, and will be illustrated with lantern slides and with experiments.

Fifth Lecture**Thursday Evening, December 4, 1924.****THE MINERAL AND VEGETABLE RESOURCES OF THE SEA.****By Ralph R. Foran, P. D.****Assistant Professor of Technical and Analytical Chemistry, Philadelphia College of Pharmacy and Science.**

The economic importance of the products of the sea is not ordinarily known or appreciated. To many, the ocean is simply a bar-

ren waste used as a means of transportation and as a source of rainfall.

Aside from the fishery products yielded by the ocean, there are many other products of vegetable and mineral origin which contribute to the welfare of man. Thus, sea-water itself contains much more than common salt. Thirty-two of the eighty known elements have been found dissolved in it. Seaweed or kelp may be made to yield more than a score of valuable substances.

The lecture, which will be illustrated, will deal with all of the resources of the sea, other than the "sea foods."

Sixth Lecture

Thursday Evening, December 18, 1924.

THE ROMANCE OF CHEMISTRY.

By Charles H. LaWall, Ph. M., Sc. D.

Chemist to Food Bureau, Pennsylvania Department of Agriculture; Professor of Pharmacy, Philadelphia College of Pharmacy and Science.

The word Chemistry comes indirectly from a root word meaning "black." There is warrant, therefore, for its having been classed with the black arts in its early days.

The search for the Philosopher's Stone and the Elixir of Life, the *ignes fatui* of the "alchemists" as the practitioners of the art were at first called, were responsible for many real discoveries of value.

Kings, queens, emperors, monks and scholars all vied with each other in studying its principles and conducting experiments in the hope of amassing great wealth or of achieving eternal youth. All of these are now passed away, but the trail of these early Spagyrist or practitioners of the Hermetic art is full of interest and of romance.

The lecturer will take his audience over this trail, which leads down to the period when the empiric art was metamorphosed into the science of chemistry.

Seventh Lecture

Thursday Evening, January 8, 1925.

THE UPS AND DOWNS OF NITROGEN.

By Ivor Griffith, P. D., Ph. M.

Physiological Chemist, Stetson Hospital, Philadelphia; Assistant Professor of Pharmacy, Philadelphia College of Pharmacy and Science.

Free Nitrogen is abundant. Free articles generally are—but it isn't of much account in living processes.

Fixed Nitrogen is comparatively scarce, and for that reason Dame Nature is very conservative with it. Over and over again she uses it. For example—what Fixed Nitrogen she loans to the living human body—when death comes with its earthen basket—Nature wants her Nitrogen back again to use in other quarters. Scientists call this bartering of Fixed Nitrogen "The Nitrogen Cycle." On the other hand, when civilization practices that uncivil finale, the cremation of the dead—civilization is committing a chemical crime. Nature is robbed of her rightful possession.

But things are better than they used to be. Time was when the world's capital of Fixed Nitrogen was surely shrinking away. Man, however, has changed the scheme—he can now, by chemical process, convert the Free Nitrogen of the air into Fixed Nitrogen. Germs were doing a bit of this long before man knew how—and the thunderstorms and the heat of the Summer Sun—but they never made enough to balance the amount that man wasted by burning the forests and his brothers.

But things are different now—and that will be the story of the "Ups and Downs of Nitrogen."

Eighth Lecture

Thursday Evening, January 22, 1925.

THE WATER SUPPLY AND ITS RELATION TO HEALTH AND DISEASE.

By David Wilbur Horn, Ph. D.

Professor of Physics and Physical Chemistry, Philadelphia College of Pharmacy and Science; Professor of Inorganic Chemistry, Wagner Free Institute of Science.

Water supply as a chemical problem has existed since time immemorial. Experience has taught that some waters are not well

adapted to continued use by men; and that some are. The chemical explanation of this problem has in part been worked out.

Water supply as a sanitary problem arises as primitive, nomadic conditions are exchanged for those of populations concentrated in fixed residential centers. From the time of the great sanitary awakening in England down to the present, this sanitary problem has been under study. The answers arrived at to date are included obviously or by implication in the arrangements for the water supplies of our large cities. This sanitary problem changes as decades pass, and the future water supply demands present consideration.

The lecture will cover various factors in these problems, past, present and future, of the water supply.

Ninth Lecture

Thursday Evening, February 5, 1925.

WHY SOAP?

By E. Fullerton Cook, Ph. M.

Professor of Operative Pharmacy and Director of the Pharmaceutical Laboratory, Philadelphia College of Pharmacy and Science.

The use of soap is so universal and so much a commonplace part of our civilization that it required a world war to bring a realization of its importance. In those countries where the inexorable demand for war material eliminated soap, its absence constituted one of the greatest hardships.

Although made by a chemical process, its origin is lost in antiquity. It is mentioned in the writings of Aristophanes (434 B. C.), also by Plato (348 B. C.), and is referred to in the Bible in the book of Jeremiah.

The making of soap in a modern factory has become an important branch of chemistry and its successful marketing a complicated and important business.

Its history and an entertaining review of the modern methods of manufacture will be presented with many illustrations and samples.

Tenth Lecture**Thursday Evening, February 19, 1925.****WHAT SHALL WE EAT?****By Horatio C. Wood, M. D.****Professor of Materia Medica, Philadelphia College of Pharmacy and Science.**

The word "vitamine" is on everybody's tongue, some of the restaurants give on their menu-cards the "Caloric value" of each dish; but the users of these words oftentimes have only very hazy notions as to what these figures mean. This lecture will discuss the uses of food as a source of energy and bodily repair; the classification of the various foodstuffs and the kinds and quantities required for health, the relative nutritive value of our common foods, the advantages of a mixed diet and other similar questions about diet which all who are interested in maintaining their health should know.

Eleventh Lecture**Thursday Evening, March 5, 1925.****CHALK AND ITS CHEMICAL RELATIVES.****By Edward J. Hughes, P. D.****Assistant Professor of Chemistry, Philadelphia College of Pharmacy and Science.**

The world is supplied with vast quantities of the material of which chalk is composed. The chemical name of this substance is calcium carbonate. The limestone rocks of the earth, the coral formations of the sea, the chalk cliffs of Dover, the stalactites and stalagmites of Mammoth Cave, are a few examples of the multifarious forms in which calcium carbonate is found.

The lecture will be an attempt to present an interesting outline of the chemical history of calcium carbonate and its wide diversity of application to the affairs of everyday life.

Lantern slides, experiments and specimens will be shown.

Twelfth Lecture

Thursday Evening, March 19, 1925.

CHEMICALS WE SHOULD KNOW.

By Frank X. Moerck, Ph. M.

**Director of the Technical Chemistry Courses, Philadelphia College of
Pharmacy and Science.**

With the progress of science and the popular application of discoveries in which chemicals perform important functions, a knowledge of the properties of the employed chemicals in so far as they may affect health and property becomes necessary; in fact, a duty. There are many substances in use today by the laity which have been used for many years by scientists and other trained persons; these substances will be so considered that the untrained persons will obtain the necessary knowledge to use them safely.

Chemicals may be used as means of generating power, heat, light and electricity, or they may be used as fire-extinguishers, cleaning fluids, insecticides, etc.

Thirteenth Lecture

Thursday Evening, April 2, 1925.

PRACTICAL DISINFECTION.

By Louis Gershenfeld, B. Sc., Ph. M.

Professor of Bacteriology, Philadelphia College of Pharmacy and Science.

What is the difference between an antiseptic and a bactericide? What are some of the most efficient disinfectants that one can employ about the home? How are they to be used? Do you know that there are discrepancies in the reports and advertisements of many of the products you are relying upon to kill deadly organisms? Do you know the limitations of the commonly used disinfectants? Are you familiar with the fact that the efficacy of these destructive agents is largely dependent upon the mode of application, the kind of material or environment to which they are applied, and other important facts which one must know to obtain the desired results?

In this lecture information will be given concerning the use of disinfectants and the lecture will point out the properties and uses of some of the disinfectants commonly employed about the home.

Fourteenth Lecture**Thursday Evening, April 16, 1925.****CONTROL OF GROWTH IN PLANTS AND ANIMALS.****By Arno Viehoveer, Ph. D.****Professor of Biology and Pharmacognosy and Director of the Botanical Gardens, Philadelphia College of Pharmacy and Science.**

An attempt will be made in this lecture, with the aid of lantern slides, to illustrate various phases of outstanding importance governing our life as well as that of other organisms. The following topics will be touched upon briefly: 1. General Discussion on Growth, Form and Function. 2. Essential Nutrients and Specific Substances Governing Growth. 3. Growth in Unicellular Plants and Animals (Normal and Abnormal—Immortal Organism). 4. Growth in Higher Organized Forms (Plants, Animals and Man—Normal and Abnormal, including Cancer). 5. Experimental Growth (a. Determination of Sex; b. Regeneration, Replacement of Tissue; c. Rejuvenation [regaining of youth]). 6. Biological and Economical Significance.

Fifteenth Lecture**Thursday Evening, April 30, 1925.****ANIMAL AVIATORS.****By Marin S. Dunn, A. M.****Assistant Professor of Botany, Philadelphia College of Pharmacy and Science.**

This lecture will discuss the following topics in relation to flight: 1. Those animals which possess the power of flying or gliding movements. Included here are such forms as insects, birds, bats, the flying fish, the flying frog, the flying lizard, the flying lemur, the flying squirrel, etc. 2. Means of flight—the nature of wings. 3. Significance of flight. 4. The possible origin of flight.

The lecture will be illustrated by charts, specimens and lantern slides.

BOOK REVIEWS

ALLEN'S COMMERCIAL ORGANIC ANALYSIS. Volume II. Fifth edition. Revised and in part re-written. Edited by Samuel P. Sadtler, B. S., Elbert C. Lathrop, A. B., Ph. D., and C. Ainsworth Mitchell, M. A., F. I. C., assisted by collaborators. 8vo. ix-807 pages, with illustrations. Philadelphia, P. Blakiston's Son & Co.

The present volume of the new edition of the well-known work of Allen will be welcome to practicing chemists in many lines. It covers the important and extensive field of the fats, fixed oils and waxes. By selecting contributors familiar with special departments of the work, the procedures have been brought up to date, and the volume offers to the analyst a comprehensive and clear summary of the methods generally approved. The editors state that they have found a tendency in modern literature to be more explicit in the description of analytic processes than was the case in former years. This is possibly due to two causes. The active work that has been doing in the standardization of analytic methods, and greatly increased official regulation of manufactured products. Standardization necessarily involves close attention to detail and analysts who are called into court are required to conform to specific methods, in which careful directions are followed.

In accordance with the plan that has been followed since the death of Mr. Allen, the editorship of the volume has been entrusted to both British and American experts. Mr. C. Ainsworth Mitchell, long and favorably known for his work in the field to which the book is devoted, contributes articles on the general chemistry of the fats, fixed oils and waxes, and also on the general analytic procedures and special characters. Individual forms are taken up by special contributors. Dr. Lathrop, one of the editors, has written the section on soaps. E. R. Bolton has revised the section on butter-fat and allied substances, G. A. Reitz furnishes the section on lard, G. H. Pickard that on linseed oil, J. W. Lawrie that on glycerol (termed "gylcerin" here, presumably in deference to technical chemists), A. H. Gill writes on wool-fat and allied substances and J. A.

Gardner on sterol alcohols. A section on the higher fatty acids has been contributed in the form of a revision by H. E. Cox.

The work is so well-established in the favor of chemists, that no general criticism is necessary. The present edition will maintain the position that it has had since the appearance of the first edition many years ago. The publisher has done full share towards making a convenient and attractive volume.

HENRY LEFFMANN.

THE PLANT ALKALOIDS. By Thomas Anderson Henry, D. Sc., Director Wellcome Research Laboratories. 2d edition. 8vo. viii-456 pages, 8 plates. Philadelphia, P. Blakiston's Son & Co.

The term "alkaloid," long used in chemistry to designate a large and somewhat incongruous group of substances, reminds one of the discovery of the first of them by Sertürner more than a century ago. It is a question whether the discoverer really obtained the alkaloid in even approximate purity, for his experiments on human beings were made with comparatively large doses without serious results. Our author fixes 1817 as the date for the discovery of morphin, but Sertürner's work began much earlier and Derosne in France also made some investigations. The conflict of these results gave rise to a somewhat sharp debate. For a long while the molecular structure of the alkaloids was a puzzle. In 1848 Wurtz discovered the compound ammonias and at once these were taken up as suggestions for the alkaloidal structure. The almost constant presence of oxygen, however, in the natural alkaloids offered a difficulty. A few active and familiar forms, such as conin and nicotin, are non-oxygenated. Fownes, the author of the familiar manual of chemistry, made the first approach by synthesis to the ordinary alkaloidal structure by his discovery of furfuran. It is now well known that most of the alkaloids can be formulated with closed chains. The theoretical questions are discussed with quite sufficient fullness in the book in hand and need not be set forth here. A classification of the group is given, but as might be expected it is somewhat arbitrary.

Dr. Henry has collected in this book a vast amount of useful information concerning the group now so important in therapeutics. A mild criticism may be made that in giving the names of the plants from which the several alkaloids are obtained, the botanist's name is rarely, if ever, attached. While most of the plants quoted are familiar and definitely named, yet, owing to synonymy, it is best to carry with the systematic name that of the describer. Speculations have been made as to function of alkaloids in plants, but the subject has no interest in connection with this book. Efforts have lately been made to develop methods of detecting alkaloids by means of the optical characters of the crystals, but great difficulties have been encountered.

The work presents a comprehensive account of the present state of our knowledge of the group.

HENRY LEFFMANN.

NEUES ILLUSTRIRTES KRAUTERBUCH. Eine Anleitung zur Pflanzen Kenntniss unter besonderer Berücksichtigung der in der Heilkunde, im Haushalt und in der Industrie verwendeten Pflanzen, sowie ihrer Volksnamen. Von Dr. Heinrich Marzell. 2 Auflage. Octavo. 709 pp. Gold Mk. 6. Ensslin & Laiblin, Reutlingen.

One of the best-known German herb books! The collaborators are: Apotheker Dr. Hugo Ziegenspeck, Dr. Med. K. Kahnt and Prof. Dr. Heinrich Marzell, Senior. Besides the numerous illustrations in the text, the work is illustrated with 32 colored plates drawn from nature by Prof. H. Morin. Each plate contains four or five different plants, which will be recognized and admired by all, being real works of art.

The division of the book is as follows:

- I Growth and Life of the Plant.
- II Natural Plant System.
- III Indigenous Plants.
- IV Foreign Medicinal and Economic Plants.
- V Plant Substitutes.
- VI Collection, Preparation and Uses of Medicinal Plants.
- VII Herbarium.
- VIII Plant Therapy.

IX Herb Books.

X Explanation of Latin Terms.

XI Index of Latin and German Names and Synonyms.

The chapter on the explanation and also derivation of Latin and Greek botanical names is very thorough and occupies six pages. This chapter alone is worth the price of the book!

OTTO RAUBENHEIMER, Ph. M.

ERLEBTES UND ERKANNTES. Von Wilhelm Wundt. 2 Auflage. Octavo. 399 pp. Cloth, \$2.40. Alfred Kröner Verlag, Stuttgart.

William Max Wundt, born 1832, died 1922, the celebrated physiologist and philosopher, wrote a wonderful book. It is not a biography, but a book on "Experienced and Recognized," or, better, "Experienced and Digested."

Wundt studied at the Universities of Heidelberg, Tübingen and Berlin and in the respective chapters tells much of the student life at these universities. He became Professor of Physiology at Heidelberg, Zürich and then Leipzig and relates a great deal of the work as well as the social features in a professor's life at these different universities. At Leipzig he founded in 1878 the celebrated Institute for Experimental Psychology. Like Johann Müller and Hermann von Helmholtz, Wundt became one of the fathers of an exact experimental natural science. In Chapter 39 he relates in a frank manner how James M. Cattell, now Professor of Experimental Psychology at Columbia University, Editor of *Science*, etc., became his assistant without salary. The fifty chapters of the book are full of experiences, intermingled with humorous incidents, which make the volume very readable.

OTTO RAUBENHEIMER, Ph. M.

DIE THEOLOGIE UND DER AERZTLICHE STAND. Von Dr. med. et phil. Paul Diepgen, Hon. Professor für Geschichte der Medizin in Freiburg. i. B. Octavo. 68 pp. Dr. Walther Rothschild, Berlin-Grunewald.

The zealous Freiburg professor and author of a popular "History of Medicine" presents here a treatise on Medicine and Theology during the Middle Ages. Among the eight chapters I want to

point out the following: "Duties of Patient Toward Physician," "Priests and Medicines," "Jewish, Arabian and Heretic Physicians," "Honorarium of the Physician" and "Responsibility of the Physician."

Inasmuch as Pharmacy, Medicine and Theology were closely connected, especially during the Middle Ages, the study of this monograph is recommended to the pharmacist, quite especially to the student of history of Pharmacy and of Medicine.

OTTO RAUBENHEIMER, Ph. M.

The German publisher B. G. Teubner, in Leipzig, submitted the two following books for review:

LEHRBUCH DER BOTANIK. Von Dr. K. Giesenhagen, Professor der Botanik und Pharmakognosie in München. 9 Auflage, mit 560 Textfiguren. Octavo. 447 pp. Cloth, Gold Mk. 7.20.

The first edition of this text was published in 1894. The present ninth edition has been brought up to date. Its division is as follows:

- I Morphology, subdivided into Organography and Anatomy.
- II Plant Physiology.
- III Special Botany, subdivided into Thallophytes, Bryophytes, Pteridophytes, Gymnosperms and Angiosperms. •

The many excellent illustrations, a total of 560, greatly help to elucidate the text. Prof. Griesenhagen succeeded in making the dry subject of botany very interesting, and for that reason the book should become better known, also in the United States.

CHEMISCHES WOERTERBUCH. Von Dr. H. Remy, Professor der analytischen Chemie Universität Hamburg. 12 mo. 416 pp. Cloth, Gold Mk. 8.60.

Germany is the fatherland of technical hand- and word-books. The progressive publisher has issued a library of such books, of which the volume before us is No. 10 and No. 11. Everything pertaining to chemistry is explained. The arrangement is alphabetical from "A" to Zymase. It is a credit to the work that biographical

data are included, and very generously included. The fifteen illustrations in the text are also a great help.

The appendix of the book furnishes a complete chemical bibliography, very cleverly divided into seventeen branches, of which we will mention the following: III. Physical Chemistry; VI. Electrochemistry; VIII. Photochemistry and Photography; X. Biochemistry; XIV. Pharmaceutical Chemistry; XVI. History of Chemistry; XVII. Chemical Journals, German and Foreign. Besides, five valuable tables are given on elements, periodic system, etc.

The valuable book is truly a chemical encyclopedia!

OTTO RAUBENHEIMER, Ph. M.

MIKROCHEMISCHES PRAKTIKUM. Eine Anleitung zur Ausfuehrung der wichtigsten mikrochemischen Handgriffe, Reaktionen und Bestimmungen. Von Friedrich Emich, Professor an der Technischen Hochschule Graz, Korresp. Mitglied der Akademie der Wissenschaften Wien. Mit 77 Abbildungen. 8vo. 177 pp. \$1.55. Verlag von J. F. Bergmann, Muenchen, 1924.

The author's "Textbook of Microchemistry" (Wiesbaden, 1911) being out of print, the book before us, just off the press, is a welcome edition, quite especially as microchemistry is getting to be more and more important.

The first part of the book treats Apparatus and Methods, Microscope, Centrifuge, etc., Reagents, Precipitation, Crystallization, Sublimation, etc. This part also contains a chapter on Quantitative Micro-Analysis in which we want to call special attention to Pregl's Alcalimetry and Acidimetry.

The second part of the volume is devoted to Micro-Analysis, containing a variety of exercises. The Inorganic Chemistry is divided into Cations and Anions and contains forty-three exercises. The Organic Chemistry contains Qualitative Elementary Analysis, Special Reactions and Quantitative Analysis, together with forty exercises.

An appendix to the book contains many excellent suggestions for the construction of simple apparatus in place of the more expensive. It is perhaps needless to say that the author has supplied a host of references, namely, 281 footnotes, thereby enhancing the value of the book, which we can highly recommend to all interested.

The pharmacist, especially the scientific pharmacist, should also become more familiar with this important subject.

OTTO RAUBENHEIMER, Ph. M.

HANDBUCH DER PRAKTISCHEN UND WISSENSCHAFTLICHEN PHARMAZIE. Unter Mitarbeit erster Fachgenossen herausgegeben von Geh. Reg.-Rat Professor Dr. Hermann Thoms, Direktor des pharmazeutischen Instituts der Universität in Berlin. 6 Lexicon Volumes. 1924. Urban & Schwarzenberg, Berlin and Wien.

Thanks to the zealous editor and his collaborators and the enterprising publishers, a new work on pharmacy is before us, bearing the title: "Handbook of Practical and Scientific Pharmacy." The work is sold on subscriptions to the entire six volumes, two of which have thus far been published.

Volume I is divided into two parts:

A. General Part. Beginning with History of Pharmacy from the pen of the late Dr. Hermann Schelenz in Kassel, this part contains many valuable monographs by authorities in their respective fields, among which we want to mention the following: "Pharmacy Laws in Germany and Other Countries," by E. Urban, in Berlin; "Dispensing and Counter Sales," by R. Bohlmann, in Dortmund; "Bookkeeping," by C. Schnabel, in Kötzschenbroda; "Hospital Pharmacy," by L. Kroeber, in München; "Military Pharmacy," by G. Devin, in Berlin; "Pharmacopœias," by the late H. Schelenz, in Kassel; "Prescription Writing and Maximum Dose Table," by A. Heffter, in Berlin. In the latter monograph the well-known pharmacologist gives the origin, history and evolution of the maximum dose table and emphasizes its necessity in an up-to-date pharmacopœia.

B. Wholesale and Retail Pharmacy. The chapter on the fitting up and the arrangement of the Apotheke according to the Government regulations of the "Vaterland" will convince even the most skeptical that pharmacy is still a profession, at least in Germany and other Continental countries. Besides the technique of light, heat and electricity, Part B consists chiefly of monographs on the description of apparatus, processes and utensils used in manufacturing

and retail pharmacy. It is perhaps needless to mention that vacuum apparatus, autoclaves, tablet machines, manufacture and filling of gelatine capsules and ampuls, pasteurization and sterilization are included. Part B contains a total of forty-three monographs, surely a true proof of the thoroughness of the work.

Volume II contains four parts, as follows:

A. Theories and Hypotheses in Physics and Chemistry, comprising Atomic Structure, Ionic Theory, Affinity and Relation Theory, all four monographs from Privat Dozent Dr. ph. et Dr. rer. pol. Th. Sabalitschka, of the Pharmaceutical Institute of the University of Berlin.

B. Physical Methods for the Examination of Medicinal Products. Among the twenty-one monographs in this part we want to call special attention to the following ones: "Specific Gravity," "Polarization," "Refractometry," "Capillary Analysis," "Colorimetry," "Calorimetry," "Viscosimetry," "Spectrum Analysis," "Microscopy and Ultramicroscopy," "Surface Tension," "Photometry" and "Kinematography." We must not forget to mention the excellent monograph on "Drops" and the drop table on pp. 268 to 272, by Stadt-oberapotheker Dr. Friedrich Eschbaum, in Berlin, a recognized authority on this subject.

C. Chemical and Biological Methods. The eighteen monographs in this part include: "Reagents and Test Solutions," "Qualitative and Quantitative Analysis," "Volumetric, Gravimetric and Gas Analysis," "Electrolysis," "Katalysis," "Colloid and Micro-Chemistry," "Synthesis and Biologic Assays," all by authorities in their respective fields.

D. Manufacture, Properties and Tests of Plant Products. This important part contains thirteen monographs, such as "Alkaloids," by Prof. Dr. J. Gadamer, Marburg, the worthy successor to Ernst Schmidt; "Glucosodes," by Prof. Dr. H. Thoms, Berlin; "Volatile Oils," by Dr. O. Simon, Miltitz; "Tannoids," by Prof. Dr. H. Kunz-Krause, Dresden; "Resins," by Prof. Dr. A. Tschirch, Bern, etc. What an array of important subjects by immortal men!

The forthcoming other four volumes will be reviewed in due time, as soon as received. Meanwhile, we wish the work the best of success and compliment the editor, his collaborators and the publishers on the latest "Handbook of Practical and Scientific Pharmacy," a title well chosen.

OTTO RAUBENHEIMER, Ph. M.